



Regional Expert Consultation on

Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific (AFERSuLiF-AP)

PROCEEDINGS AND RECOMMENDATIONS



Asia-Pacific Association of Agricultural Research Institutions



Virtual Regional Expert Consultation on

Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific (AFERSuLiF-AP)

October 13-14, 2021 via  zoom

PROCEEDINGS AND RECOMMENDATIONS

Asia-Pacific Association of Agricultural Research Institutions

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Foreword

It is well known that the idea of agroforestry stemmed from the need of mitigating the effects of global warming, and to adopt a long-term vision for tackling food insecurity in more sustainable farming methods. A need was always felt to have a platform to discuss on importance of agroforestry at all levels, to mainstreaming agroforestry through enabling policies and scaling-up investment in agroforestry, and to share the lessons from the success and failure in agroforestry entrepreneurship, and so also to prioritize regional needs to achieve Sustainable Development Goals (SDGs). Keeping this in view Asia-Pacific Association of Agricultural Research Institutions (APAARI) organized a Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific with active partnership of Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF) and Council of Agriculture (COA), Taiwan, on October 13–14, 2021. It is heartening to note that the event was attended by a vast array of global experts and regional stakeholders of Asia-Pacific.



The Expert Consultation came out with some very important recommendations including highlighting the need for a new paradigm of inter-sectoral planning and policy for each country to scale up practice of agroforestry and also for giving due importance to specific local farm innovations with farmers as core innovator and focused around different public and private stakeholders. The need for having National Agroforestry Policies was stressed upon for scaling up the innovations, bringing in investments and converging stakeholders to one platform and so also for carbon financing of agroforestry plantations. It was also recommended that Agroforestry Business Incubators should be linked with industries and markets in sourcing raw materials direct from farmlands, ensuring that farmers get the best prices for their tree products and for establishing the market-linked value chains to facilitate income generating activities for smallholders including women farmers in agroforestry. There were some useful recommendations for acting at regional level on researchable agendas, capacity development, regulatory policy development and public awareness, and potential partnerships. The need of continuous scientific communication activities including documenting and sharing of lessons learnt was also emphasized.

On behalf of APAARI and on my personal behalf I thank all the experts and participants for their very thoughtful contributions which permitted to capture and prioritize the way forward at regional and country level. I take this opportunity to thank Dr Rishi Tyagi, APCoAB Coordinator of APAARI for conceiving and organizing the event and wholehearted thanks to all the co-organizers of the event and to all the experts who contributed for developing the Proceedings in such a succinct manner.

APAARI stands committed to promote the importance of agroforestry in the region and invite all those who are keen to have collaborative ventures towards sustainable development of agroforestry for meeting the SDG targets.

A handwritten signature in blue ink, appearing to read 'Ravi Khetarpal'.

Ravi Khetarpal, PhD
Executive Secretary, APAARI

Acknowledgements

On behalf of Asia-Pacific Association of Agricultural Research Institution (APAARI), and its programme Asia-Pacific Consortium on Agricultural Biotechnology and Bioresources (APCoAB) and my own behalf, I would like to thank Dr Ravi Khetarpal, Executive Secretary, APAARI, Thailand and Prof. Tony Simons, Managing Director, Center for International Forestry Research-World Agroforestry (CIFOR-ICRAF), Kenya and Mr Vincent Lin, Director General, Council of Agriculture (COA), Taiwan, for sparing valuable time and delivering their valuable remarks in the opening session.



Thanks are due to Dr Javed Rizvi, Director Asia and Regional Coordinator South Asia, CIFOR-ICRAF, India, and Dr Shiv K. Dhyani, Country Coordinator-India and Senior Agroforestry Specialist, CIFOR-ICRAF, India, for their unstinted support for developing the technical agenda, identifying the experts for deliberation during the meeting, and mobilizing the participation across the Asia-Pacific region and Africa.

I thank immensely to the Co-Organizers, CIFOR-ICRAF, Kenya and India and COA, Taiwan for whole-hearted support in organization of the Virtual Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific, which was held on October 13-14, 2021.

While organizational support was important, strategic and technical inputs of individuals were also very critical. Special thanks are placed on record for significant contributions of Dr Devashree Nayak, and Dr Archana Singh, scientists at CIFOR-ICRAF, India, who had been a great support in arranging logistics and in many other ways during organization of the Regional Expert Consultation on Agroforestry.

My sincere thanks to all the co-chairs to conduct the session efficiently. Special thanks to the rapporteurs, namely, Drs Devashree Nayak, Atul Dogra, Raj Kumar Singh, Archana Singh, and Sunil Londhe, Aqeel H. Rizvi and Swati Renduchintala – all from CIFOR-ICRAF, who recorded the proceedings during the sessions meticulously. Thanks to all the speakers for making the presentations and panelists for presenting their views on the defined topics during panel discussion. Many thanks are due to all the participants to engage in lively discussion.

I am thankful to my all colleagues in APAARI, especially Mr Jack Lin, Technical Associate, APCoAB, for his intense engagement and logistic support extended by him in organizing the meeting.

Sincere thanks are accorded to all the co-editors, especially Dr Atul, Former Director (Retd.) CSKHP Agricultural University, Palampur, Himachal Pradesh, India for his intensive involvement in extracting the content of deliberations from audio-visual recordings meticulously and in collation and compilation of the proceedings.

I hope that the recommendations presented in this document will draw attention of the policy makers, administrators, researchers, donors and other stakeholders to harness maximum potential of agroforestry for the benefits of the farmers in the Asia-Pacific region.

Rishi K. Tyagi
Coordinator, APCoAB, APAARI, Thailand

Organizers and Collaborators

Asia-Pacific Association of Agricultural Research Institutions (APAARI)

<http://www.apaari.org>



The APAARI, with its headquarters in Bangkok, is a unique voluntary, membership-based, self-mandated, apolitical, and multi-stakeholder regional organization in the Asia-Pacific region. It promotes and strengthens agriculture and agri-food research and innovation systems through partnerships and collaboration, capacity development, and advocacy for sustainable agricultural development in the region. Since its establishment in 1990, APAARI has significantly contributed towards addressing agricultural research needs and enhancing food and nutritional security in the region. The close links, networks, partnerships, and collaboration with stakeholders that APAARI has developed over the years, as well as its goodwill, authority and focus on results, make the Association an important organization in the region. The ultimate aim of APAARI is to help realize sustainable development goals in Asia and the Pacific.

Centre for International Forestry Research-World Agroforestry (CIFOR-ICRAF)

<https://www.cifor-icraf.org/>



CIFOR-ICRAF is a world-class research institution which delivers actionable evidence and solutions to transform the way land and renewable resources are used, and how food is produced. It evolved out of the effective merger between CIFOR and ICRAF has more than 65 years of combined expertise. Its joint mission is to build, disseminate and apply evidence about the role of trees, forests and tree-based agriculture as pathways to solving global crises such as poverty, hunger, land degradation, climate change, and unsustainable supply and value chains. In short, to improve people's lives while preserving the environment. CIFOR-ICRAF develop and deliver evidence-based, actionable solutions to address the most pressing global challenges by working closely with farmers, forest communities and a wide range of partners. In addition, CIFOR-ICRAF also drive the international dialogue on sustainable land use by convening large-scale events and establishing communities of practice through the Global Landscapes Forum.

Asia-Pacific Consortium on Agricultural Biotechnology and Bioresources (APCoAB)

<http://www.apaari.org/web/our-projects/apcoab>



The APCoAB, established in 2003 under the umbrella of APAARI, has the mission to harness the benefits of agricultural biotechnology and bioresources for human and animal welfare through the application of the latest scientific technologies while safeguarding the environment for the advancement of society in the Asia-Pacific region. APCoAB's main objectives are to (i) serve as a neutral forum for the key partners engaged in research, development, commercialization, and education/learning of agricultural biotechnology as well as environmental safety in the Asia-Pacific region; (ii) Application of biotechnological tools for bioprospecting, conservation and sustainable use of bioresources; (iii) facilitate and promote the process of greater public awareness and understanding relating to important issues of IPRs, *sui generis* systems, biosafety, risk assessment, harmonization of regulatory procedures, and access and benefit-sharing to address various concerns relating to the adoption of agricultural biotechnology and sustainable use of bioresources; and (iv) facilitate human resource development for meaningful application of agricultural biotechnology and use of bioresources to enhance sustainable agricultural productivity, as well as product quality, for the welfare of both farmers and consumers.

Council of Agriculture (COA)

<http://www.tari.gov.tw/english>



The COA, Taiwan, is the competent authority on agricultural, forestry, fishery, animal husbandry, and food affairs in Taiwan. Its responsibilities include guiding and supervising provincial and municipal offices in these areas. Under the council, there are Department of Planning, Department of Animal Industry, Department of Farmers' Services, Department of International Affairs, Department of Science and Technology, Department of Irrigation and Engineering, Secretariat, Personnel Office, Accounting Office, Civil Service Ethics Office, Legal Affairs Committee, Petitions and Appeals Committee and Information Management Center respectively in-charge of related affairs.

Abbreviations and Acronyms

| | |
|------------|---|
| ACIAR | Australian Centre for International Agricultural Research |
| APP | Application |
| ASEAN | Association of Southeast Asian Nations |
| BMZ | Bundesministerium Für Wirtschaftliche Zusammenarbeit (German Federal Ministry for Economic Development Cooperation) |
| CABI | Centre for Agriculture and Bioscience International |
| CAFRI | Central Agroforestry Research Institute |
| CAI Curve | Current Annual Increment Curve |
| CARE-DEFOR | CARE Deforestation Project |
| CER | Certified Emission Reduction |
| COVID-19 | Coronavirus Disease |
| CRIDA | Central Research Institute for Dryland Agriculture |
| CSA | Climate Smart Agriculture |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| CSKHP | Chaudhary Sarwan Kumar Himachal Pradesh |
| CSR | Corporate Social Responsibility |
| ESCAP | United Nations Economic and Social Commission for Asia and the Pacific |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FSC FM | Forest Stewardship Council - Forest Management |
| FTA | Forest, Trees and Agroforestry |
| GEF | Global Environment Facility |
| GHG | Greenhouse Gas |
| GIAHS | Globally Important Agricultural Heritage System |
| GIS | Geographic Information System |
| ha | Hectare |
| ICAR | Indian Council of Agricultural Research |
| ICARDA | International Center for Agricultural Research in the Dry Areas |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| ICT | Information and Communication Technology |
| IFAD | International Fund for Agricultural Development |

| | |
|-----------|--|
| IFPRI | International Food Policy Research Institute |
| IGFRI | Indian Grassland and Fodder Research Institute |
| IGO | Intergovernmental Organization |
| INDCs | Intended Nationally Determined Contributions |
| IPCC | Intergovernmental Panel on Climate Change |
| IPRs | Intellectual Property Rights |
| IUFRO | International Union of Forest Research Organizations |
| KM | Knowledge Management |
| LPG | Liquid Petroleum Gas |
| MAI curve | Mean Annual Increment curve |
| MAPs | Medicinal and Aromatic Plants |
| MDF | Medium-density Fire |
| MEL | Monitoring, Evaluation, and Learning |
| NABARD | National Bank for Agriculture and Rural Development |
| NARS | National Agricultural Research System |
| NASA | National Aeronautics and Space Administration |
| NGO | Non-Governmental Organization |
| NRM | Natural Resource Management |
| SAARC | South Asian Association for Regional Cooperation |
| SARP | South Asia Regional Programme |
| SCOLUR | Scaling up Cocoa-based Food Systems, Land Use and Restoration |
| SDGs | Sustainable Development Goals |
| SMEs | Small, Medium-Sized Enterprises |
| TAP-CDAIS | Tropical Agriculture Platform and a Common Framework on Capacity Development for Agriculture Innovation System |
| TBOs | Tree-borne Oilseeds |
| TOF | Trees Outside Forests |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UN-REDD | The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation |
| USAID | United States Agency for International Development |
| USDA | United States Department of Agriculture |
| VER | Voluntary Emission Reduction |
| WSG | Wild-simulated Ginseng |
| WTO | World Trade Organization |

Executive Summary

Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific (AFERSuLiF-AP) was organized virtually and jointly with APAARI, Thailand; Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF); and Council of Agriculture (COA), Taiwan on October 13–14, 2021. Opening remarks were presented by Mr Tony Simons, Executive Director, CIFOR-ICRAF; Mr Vincent Lin, DG, COA and Dr Ravi Khetarpal, Executive Secretary, APAARI. Eminent global experts from 9 countries contributed to the discussion during the Regional Expert Consultation. Some 199 participants registered for the consultation, out of which 153 (researchers and research managers from governments, academia, industry and NGOs) took part from 23 countries (Australia, Bangladesh, Bhutan, Canada, Egypt, Fiji, Germany, India, Iran, Japan, Kenya, Lao PDR, Republic of Korea, Malaysia, Nepal, Pakistan, Papua New Guinea, Sri Lanka, Taiwan, Thailand, The Philippines, The United States and Vietnam) including from NARS, universities, related ministries, and CG Centre. Of 153 participants, 26% were women scientists/experts. The objectives of the Regional Expert Consultation were (i) to enlighten the stakeholders on sustainable development through agroforestry in the region, and (ii) mainstreaming agroforestry through enabling policies and scaling-up investment in agroforestry, and (iii) to share the lessons from the success and failure in agroforestry entrepreneurship, and (iv) to prioritize regional needs identified, especially to achieve SDGs during the Regional Expert Consultation.

Expert Consultation comprised of 3 Technical Sessions and 1 Panel Discussion — (i) Sustainable Development through Agroforestry, (ii) Enabling Policies and Scaling-up Investment in Agroforestry, (iii) Agroforestry and Entrepreneurship: Lessons from Success Stories, and (iv) Panel Discussion on Regional Priorities (Research Areas, Capacity Development, Regulatory Policy Development & Public Awareness, and Possible Partnerships) to Achieve SDGs. A total of 16 presentations were made by the experts related to the different themes of a session.

Of the 2-day deliberations during expert consultation on agroforestry, key recommendations emerged which are mentioned below:

Sustainable Development through Agroforestry

- A new paradigm of inter-sectoral planning and policy is essential for each country to scale up practice of agroforestry.
- Context-specific local farm innovations with farmers as core innovator and focused around different stakeholders, especially private sector engagement is needed.
- Landscape-based natural resource management with agroforestry is recommended to increase overall agroforestry system resilience.
- For successful and economically viable agroforestry, plantation needs to be done using advance clones, quality planting material, and efficient nursery management.

Enabling Policies and Scaling-up Investment

- Transformational changes through National Agroforestry Policies signify its importance in scaling up, bringing in investments and converging stakeholders to one platform, therefore, each country needs to have National Agroforestry Policy.
- Considering the decreasing carbon stocks from forest, agroforestry can help in carbon sequestration. Therefore, there should be carbon financing of agroforestry plantations and opening of a Carbon Registry for trading certified emission reductions (CERs)/voluntary emission reductions (VERs).
- National governments should also address the land tenure issues to promote and scale-up agroforestry to encourage particularly the women farmers.

Agroforestry and Entrepreneurship

- Biophysical similarity mapping, digital augmentation are future technologies for scaling-up, site-specific agroforestry that help inter-linking vital elements of complex smallholder farming systems transition.
- The Multi-chain Approach Portfolios, an agroforestry approach, suitably be adopted at national level to promote greater diversity of food tree species and crops on farms to enhance seasonal food resilience and diversify diets at local levels.
- Agroforestry business incubators should be linked to industries and markets in sourcing raw materials direct from farmlands, ensuring that farmers get the best prices for their tree products.
- Establishment of market-linked value chains are necessary to facilitate income generating activities for smallholders including women farmers in agroforestry.
- Understand the markets for agroforestry products and find the ways to reduce the risk for investors to help create market pull.

Regional Priorities (Research Areas, Capacity Development, Regulatory Policy Development & Public Awareness, and Possible Partnerships)

- Political, Scientific and practical implementation knowledge are interconnected, and their integration is essential for functions and contribution of agroforestry in achieving SDGs.
- Innovation in agriculture is not only just technology but also process, organizational forms, communication and awareness along with understanding of various actors and their roles in agroforestry.
- Inadequate knowledge of sustainable approaches restricts the interest of policy-makers in agroforestry development. There is a need of continuous scientific communication activities to gain widespread public consensus engaging institutions.
- Dissemination of knowledge, modern science, policy and communication-awareness are interlinked and synergy is the need for scaling up of agroforestry in the Asia-Pacific Region.
- Experience, lessons and successful cases on agroforestry should be documented which will help the region to promote agroforestry.

Proceedings of the First Day of the Virtual Regional Expert Consultation

Day 1: October 13, 2021

Virtual Regional Expert Consultation on Agroforestry *via* Zoom was initiated by Dr Rishi K. Tyagi, Co-ordinator of APCoAB of APAARI, Thailand, on October 13, 2021. He introduced the main theme and the importance of this Regional Expert Consultation on Agroforestry for Environmental Resilient and Sustainable Livelihood in Asia-Pacific region. During two-day consultation meet, it was emphasized upon all the participants to bring out recommendations to promote agroforestry for environmental resilience and sustainable livelihood of the smallholder farmers in Asia-Pacific region.

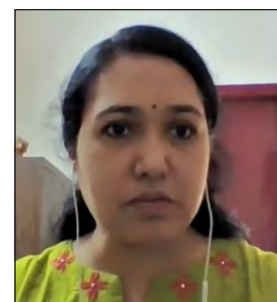


Rishi K. Tyagi

Dr Tyagi set the ground rules for the presentation and the same was presented in the form of a slide entitled “Rules for the housekeeping for the house”. The purpose of the same was for the convenience of Session Chair/Co-chair and all the speakers. The session was then handed over to Dr Devashree Nayak, CIFOR-ICRAF — South Asia to start with the proceedings of opening session accordingly.

Opening Session

The Opening Session was moderated by Dr Devashree Nayak, Agroforestry and Gender Research Scientist, CIFOR-ICRAF—South Asia, New Delhi, India. She welcomed the participants to the meeting and introduced the speakers of the opening session. Dr Nayak invited the dignitaries by giving their brief professional background of Dr Tony Simons, Managing Director, CIFOR-ICRAF, Kenya; Mr Vincent Lin, Director General, COA, Taiwan and Dr Ravi K. Khetarpal, Executive Secretary, APAARI, Thailand.



Devashree Nayak

Speaker: Tony Simons, Managing Director, CIFOR-ICRAF

Professor Tony Simons mentioned that the expert consultation on agroforestry was timely with the issue that we have been facing in the world today with deforestation with land degradation, climate change and biodiversity loss, *etc.* The title also portrayed the link between the environment and people. The livelihood option is often missing and generally our focus particularly is on production and land only. The organizers were congratulated by him for the very idea of this expert consultation on an extremely important issue by focusing on these two elements — forest and livelihood together at this point of time as “Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific region”.



Tony Simons

He further highlighted that at the end of the last Ice Age, Asia-Pacific was endowed with more than 80% forest cover. Humans derived the goods and the services that they needed, from trees and those intact forests in the region and the huge resources that could be used.

The forest transition curve showed that with clearing, burning and ultimately the human settlements came destruction of the forests in this region of the world and the presence of the primary forests was very low as the deforestation came with the agriculture development in the society. Agroforestry was like any other term used to refer the conversion of land use back to more sustainable natural systems as well as sustainable human systems. Some people describe agroforestry as “the right tree for the right place for the right reason”. Land equivalence ratios have often been used to describe agroforestry as we get goods and services from crops, grass and livestock and that is seen as an agricultural component. While talking in terms of trade-off, areas for forestry were segregated in our landscape. In the value of goods and services from the trees in the shop, component is seen as forestry. Agroforestry has been trying to combine land uses together in same area of land, may be in different timescales, but to synergise to get more out of the area.

Professor Tony elaborated the basic concept of agroforestry. In his words “we don’t need to get too hung-up on using the term agroforestry. There are many new terms are emerging like nature-based, ecosystem-based solutions, agro-ecology, trees outside forests, etc. We should not have conflicts on the agroforestry definition in the manner of wars or territorial belongingness like who owned the word ‘land use practices’ or who owned a ‘system or approach’ concept, etc. The thing about all those other terms apart from agroforestry was that they lacked the evolved definitions, the definitions that had changed, evolved and strengthened overtime. The general search for agroforestry gives 1.8 billion referred articles published on agroforestry. The word agroforestry was only invented in 1977. Amazingly, there are National Institutes also, like National Institute for Agroforestry in India. Several countries in the region also have National Policy. Nepal, very recently, had a National Policy on Agroforestry following India, the first one in region in 2014. Thus, one of the strengths of agroforestry is that it can support a lot of the environmental, agricultural, commercial land use initiatives going on that may not be labelled necessarily as agroforestry.

Tony Simons

Executive Director CIFOR-ICRAF
Director General ICRAF
Nairobi, Kenya

Tony Simons has worked for 27 years on issues at the tropical agriculture/forestry interface in more than 40 developing countries. His work has spanned the private sector (Shell Forestry), academia (University of Oxford), official development assistance (FCDO) and research (CGIAR). He holds a bachelor’s degree in agricultural science from Massey University, NZ, and master’s and doctoral degrees from Cambridge University, UK.

In 2009, Tony was made an Honorary Professor in Tropical Forestry at the University of Copenhagen. He is a board member of the African Centre for Technology Studies, the Plant Resources of Tropical Africa program, the Danone Livelihood Fund and DCM International Imaging. He also leads the IUFRO Forest and Water Task Force. He has published over 100 research papers and has sat on several journal editorial boards.

Tony’s interests span the seven major research themes of ICRAF, encompassing: tree germplasm; agroforestry systems; tree product marketing and extension; land health; climate change; environmental services and policies; and tropical forest margins. He is passionate about the transformative and profitable change that the private sector can bring to development.



He further stated that it was great that this conference in virtual dialogue was going to look at land element, land use element and how individuals, communities and national authorities in countries had been managing their lands. While talking of the livelihood, there is a need to look at the social dimensions and within that to look

at gender issues and inequity between smallholders and large producers and others in the system, under various land use systems and practices.

Professor Tony also emphasized upon the concept of supply chain. The supply chain does not start when we plant the seed or spread the fertiliser and it does not end at consumption. Post consumption issues and waste issues are as important as other things in our traditional linear supply chains. He was of the opinion that it was really an important concept that we have to progress agroforestry in the Asia-Pacific region.

Lastly, he requested to look at the CIFOR strategy, its approaches, the ways that they had operationalized it through landscape, transformative partnership platforms and also flagship products. He concluded that it was an absolute delight that APAARI, ICAR and other National Institutes want to progress this land use practice, land use system, ways of regenerating land and connecting social communities together. In the end, he was thankful for the opportunity given to him and will be looking forward to the deliberations and the outcomes from this meeting.

Dr Devashree, session moderator thanked the speaker and introduced the next speaker of the opening session by giving his brief introduction.

Speaker: Vincent LIN, Director General, COA

Mr Vincent Lin started his address by greeting Dr Ravi Khetarpal, Dr Tony Simons, Dr Rishi Tyagi and all distinguished guests and participants. He felt honoured to be part of the virtual Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihood of Farmers in Asia-Pacific. On behalf of COA, Taiwan, he thanked APAARI and CIFOR-ICRAF for hosting this important and meaningful event. Further he stated that agricultural production and food industries have changed geometrically over the past few decades. Climate change have roles, barriers and severe challenges such as, depletion of natural resources and adverse impacts of environmental degradation including desertification and land degradation, fresh water scarcity and loss of biodiversity, etc. This undermines the ability of all countries to achieve sustainable developments. The IPCC published special reports on global warming of 1.5°C in 2018 and pointed out that in order to control the global temperature, there is a need to ensure net zero carbon emission.

According to him, agroforestry contributes to the achievements of a wide range of sustainable development and can be particularly important for small-scale farmers because it generates diverse products and services on limited land area. Therefore, the government of Taiwan has launched forestry sustainability diversified promoting programmes and suitable lands for bringing under forests' economy policy which in the end will be encouraging for the development of agroforestry. The forest farmers are allowed and encouraged to grow products such as mushroom, etc. under forest technology, technical standard projects with certain conditions such as not to destroy the natural growth of forest trees, maintain forest vegetation and remaining economic benefits from operating forestry by-products. The under-forest economy can not only increase the short-term income of



Vincent LIN

Vincent LIN
Director General
Department of International Affairs,
Council of Agriculture (COA), Taiwan

Vincent Lin has served in various positions such as Director, Secretariate, COA; DDG, International Affairs, COA; Secretary, Permanent Mission of Taiwan, Penghu, Kinmen and Matsu to the WTO. Vincent is serving as Board member of Rural Economics Society of Taiwan and Taiwan Agribusiness Management Association. He has specialization in agricultural trade negotiations and partnerships with international organizations.

forest farmers but will also improve the ecological value of the environment. For example, under-forest beekeeping will increase the plantation rates and natural regeneration of forestry. Therefore, farmers can produce more and more foods and increase profits while reducing negative impacts on the environment through promotion of the under-forest economy and other carbon reduce measures.

He further highlighted that the governments are working towards the goal of net zero emission and sustainable agriculture. He was confident that this meeting will provide a great platform for all the policy makers, experts and researchers to exchange views and discuss important issues of agroforestry and believed that with everyone's contributions and inputs, this meeting will yield fruitful outcomes and valuable suggestions for this region. Finally, he again expressed his gratitude to APAARI and CIFOR-ICRAF for their great preparation for this event, sincere thanks to the presence of all participants and guests assembled online and wished the workshop a grand success.

Dr Devashree thanked the speaker and summed up with the remarks that Dr Vincent Lin had very nicely highlighted the importance of agroforestry especially for the smallholders, how Taiwan is taking up the agroforestry in the country and how the smallholder farmers can harness the benefits from the country policy interventions for agroforestry.

Dr Devashree introduced the next speaker of the opening session.

Speaker: Ravi Khetarpal, Executive Secretary, APAARI

Dr Ravi Khetarpal, Executive Secretary, APAARI, Thailand, greeted and welcomed all the participants from various time zones of the region for attending this virtual Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihood of Farmers in Asia-Pacific. He further expressed his special thanks to Dr Tony Simons, Managing Director, CIFOR-ICRAF, Mr Vincent LIN, Director General, COA, Taiwan. He also welcomed Dr Ravi Prabhu, Dr Javed Rizvi, Dr Shiv Dhyani, Dr Archana Singh, all colleagues from ICRAF-CIFOR, ICAR, all the expert members of APAARI and his colleague Dr Rishi Tyagi, who took a lead in organising this two-day Expert Consultation.



Ravi Khetarpal

In this jointly organised event, Dr Simons had rightly pointed out the keywords of the topic which were very crucial. Dr Khetarpal appreciated Dr Simons for his very brief and crisp presentation.

Dr Khetarpal was of the opinion that agroforestry is more inclusive than agriculture *per se*, as a subject to address the global environmental, economic and social ecological systems special in the Asia-Pacific region. The subject should have gained more attention in the region than it got or maybe he was ignorant of the high importance that it has attained. It was very much clear from the successful CGIAR research programme on forest, trees and agroforestry (FTA), which is being the world's largest research development programme to enhance the role of forest, trees, agroforestry towards sustainable development, food security and to address the climate change. CIFOR led FTA was in partnership with so many other organizations, but was supported by CGIAR fund only. In his own words, "We are now in the era of climate change and also in the era of giving high importance to innovation. This is what we see very clearly with the topical agricultural platform of Food and Agriculture Organization of the United Nations (FAO). The same is mentioned as a G20 initiative, where the whole crux of the solutions for all problems lies to a great extent. The very purpose of this regional consultation is to enlighten the stakeholders on sustainable development through the agroforestry in the region and more importantly to have a discussion on enabling policies, on mechanisms to scale-up investment and also its role in value chain enhanced entrepreneurship. All the

regional parties will be highlighting these in various sessions, very properly conceived in this two-day meet”.

He further made the wide group of participants aware about APAARI which is a membership-based, apolitical, self-mandated regional organization which was born from the womb of FAO as an initiative about 31 years back in Bangkok. This organization had been doing a good job for the region and since inception, had been trying to bring all regional players at one platform. Now, since last 3-4 years APAARI has been going into a transformation, moving forward with a clear vision and an operational plan too, for what can be done for the partners and the members. In fact, this organizational overhauling is going on in most of the organizations globally with change of priorities, changes coming with focus on resources available. In his view, it was a very good which is going on globally and will actually be helpful to keep sharp focus on what is to be done as right now most of us were passing through a very difficult stage. All the organizations will overcome this stress and pressure arising due to complete change very soon. Briefly, in APAARI, now they are actively pursuing their legal status as an independent quasi-Intergovernmental Organization (IGO) with Ministry of Foreign Affairs in Thailand.

He informed that APAARI’s membership status is being reviewed and its constitution is being revised. Only countries will be taken as members and all the rest will be like development partners, which is the case with most of the IGOs globally. Once the CG membership has been finalised, management standards have been put into place. The CG itself is going through a lot of stress and is in the process of evolution. He further pointed out that ICRISAT has agreed to be an independent member of APAARI in the coming years or probably next year and in his personal opinion, the CIFOR-ICRAF may also look into this. APAARI is being expanded now, partnership and resource mobilization is bringing new focus and key for the organizational growth.

APAARI is now scoping, developing and bringing projects for its partners on innovation from FAO, risk mitigation from WTO, capacity building, functional capacities and communication strategies with EU, agriculture science and technology indicator (ASTI) project with the support of ACIAR, in partnership with IFPRI. There is also support of USDA for risk mitigation project. APAARI has the support of Council of Agriculture represented ably by Mr Vincent LIN to financially support a programme APCoAB.

APAARI has restructured the constitution to make it a more viable and more vibrant organization in the region. Besides, it is gradually shifting its focus towards policy issues. He further assured all the participants that APAARI will get back with its revised contribution and its different approach of working once it had its system in place very shortly. It was also proposed to have another meeting to see how APAARI can strengthen its partnership also with CIFOR-ICRAF which have been a valuable partner earlier and push the subject of agroforestry in the region. He also invited all the participants to use this platform for networking and collaboration. Further he stressed to let the organization know what work or more action plan APAARI can

Ravi Khetarpal

Executive Secretary
APAARI, Thailand

Dr Khetarpal is Executive Secretary of APAARI since 2017 and is based in Bangkok. He promotes and facilitates APAARI’s vision of strengthening agricultural research and innovation for sustainable agricultural development in the region through networking amongst more than 80 members. He coordinates APAARI’s projects sponsored by international and bilateral organizations on knowledge management, agriculture innovation systems, agriculture science technology indicators, strengthening phytosanitary compliance for international seed movement and pesticide risk mitigation in various countries of the Asia–Pacific region. He is the current Chair of the Global Forum of Agricultural Research and Innovation (GFAR), and the Tropical Agricultural Platform of FAO — a G20 initiative for developing and promoting the agricultural innovation system. He has served CABI — South Asia (India) as Regional Director and also as its Regional Advisor on strategic science partnerships for a span of more than seven years. Prior to that, he worked for the National Agricultural System in India in the field of plant protection for 30 years. He holds a PhD in life sciences (plant pathology) from the University of Paris and was a Visiting Scientist in an EU Collaborative Project at Institut National de la Recherche Agronomique (INRA), Versailles, France for three years.

initiate in the domain of agroforestry with more interactions, more partnerships, and more collaborations in the years ahead. With these remarks, he concluded and thanked all once again for the active involvement and participation.

Dr Devashree thanked Dr Tony Simons, Mr Vincent LIN and Dr Ravi Khetarpal for their valuable remarks underlining the importance of agroforestry. She also thanked all the participants, from different countries located in different time zones for attending the opening session.

Dr Rishi Tyagi convened the Technical Session 1 on Sustainable Development through Agroforestry, proceedings are discussed hereunder in next section.

Session 1: Sustainable Development through Agroforestry

Session Chair: Ravi Prabhu, CIFOR-ICRAF

Rapporteurs: Atul Dogra, CIFOR-ICRAF and Raj Kumar Singh, CIFOR-ICRAF

Dr Rishi Tyagi initiated the first technical session on Sustainable Development through Agroforestry and invited Dr Ravi Prabhu from CIFOR-ICRAF to chair the session. Key speakers of the session — Dr Shiv Dhyani from CIFOR-ICRAF, India; Dr Ravi Prabhu, CIFOR-ICRAF, Indonesia (who was also one of the speaker) and Dr Ramesh Singh, ICRISAT, India, were introduced.

Topic: Overview and Potential of Agroforestry

Speaker: Shiv K. Dhyani and Javed Rizvi, CIFOR-ICRAF

Dr Dhyani stated that his presentation was a joint work for which he duly acknowledged the support of his co-authors especially Dr Sunil Londhe, Soil Scientist, Geoinformatics Specialist, who could not participate. Before starting the presentation, he mentioned briefly about the organizations which were being represented by the authors. ICRAF and CIFOR are recognised international research centres catering to the respective fields of agroforestry and forestry, with headquarters of ICRAF at Kenya and that of CIFOR at Indonesia.



Shiv Dhyani

He started with the term Agroforestry which for a common person was agriculture with trees. It can be said more comprehensively that “agroforestry is the practice and science of the interface and interactions between agriculture and forestry involving farmers, livestock, trees and fodder at a landscape”. According to him, agroforestry had been a traditional system for this region and especially for the South Asia, well within grip of science with models and systems.

He mentioned about Sustainable Development Goals (SDGs) and highlighted that out of 17 SDGs, agroforestry contributes significantly on 9 SDGs. In addition to that, agroforestry is included as an important sustainable management approach for climate change adaptation and mitigation and also support the indigenous community for livelihood benefits. Important agroforestry systems were emerging as vital solution for climate adaptation.

In fact, at the global level also in Paris Accord 2015, 23 countries have identified agroforestry as a mitigation strategy, while 29 countries identified agroforestry as an adaptation strategy. Till 2019, it has been analysed

that out of 148 nationally determined contribution almost 40% of them explicitly mention agroforestry adapted as a measure for climate change mitigation. In the inaugural session also, it was mentioned that 21% of Asia and Pacific region undertake agroforestry intervention in the areas.

From the global perspective to regional perspective, agroforestry has been receiving attention by various institutions like CIFOR, ICRAF and APAARI, *etc.* In 2015 in New Delhi Declaration also, there has been a mention about need of agroforestry in different countries of the region.

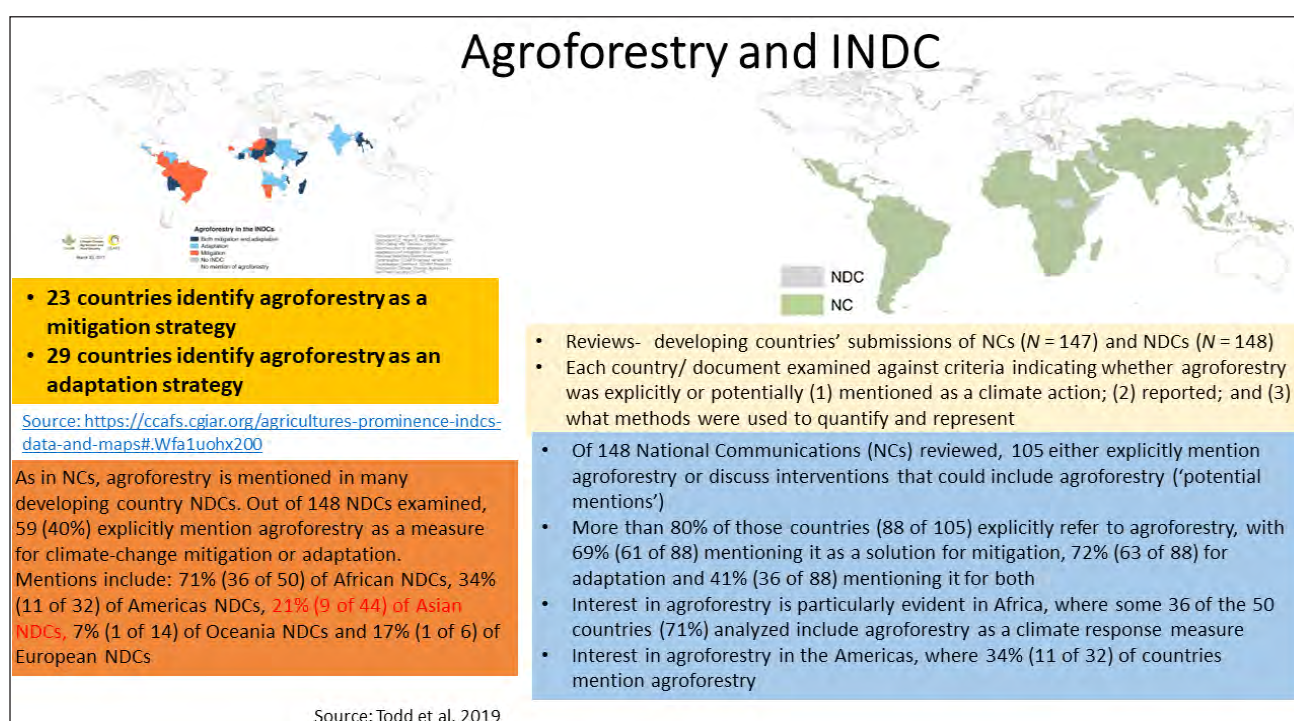
There has been SAARC resolution on agroforestry in 2016 where different ministries of all 8 countries of the region came together for implementation of agroforestry in South Asia region. He presented few examples where action has already been taken on agroforestry.

He further clarified that there was only the need to identify the right tree for the right place to get all the direct benefits *e.g.*, food, firewood, fuel, fodder, medicines, *etc.* In addition to that, there were indirect benefits when the trees contribute to the soil fertility, carbon sequestration, soil erosion, watershed protection and biodiversity. Benefits which accrue from agroforestry like the production of food, commodity, energy, medicinal and aromatic plants (MAPs), timber, *etc.* Thus, agroforestry provides the social benefits, communal benefits, environmental benefits and economic benefits. He specially mentioned examples like Jackfruit in Bangladesh — where a large economy of the small and marginal farmers depends on the agroforestry models of the country. Moringa is another very good example which not only fulfils the fodder demand but there are a lot of medicines — the valuable products which come out of the Moringa-based agroforestry systems. Innumerable examples of spices, timbers, *etc.* are available in the literature.

Shiv K. Dhyani

Country Coordinator, India
Senior Agroforestry Specialist,
CIFOR-ICRAF, India

Dr Shiv Kumar Dhyani joined ICRAF South Asia Regional Program (SARP) as an Agroforestry Specialist from the Indian Council of Agricultural Research (ICAR) where he served in various senior positions, including two terms as Director of India's Central Agroforestry Research Institute (CAFRI). As one of the leading scientists of ICAR, he played an important role in the development and implementation of the Indian agroforestry policy, agroforestry mission, and the recently initiated bamboo mission. Dr Dhyani has contributed to the regional research and development agenda of South Asia and is well connected to the entire agroforestry fraternity of India, the region, and at the global level.



The carbon storage is the mitigation aspect whereas the water regulation, quality, microclimate regulation, economic opportunity, biodiversity, cultural values are the adaptation strategies built in the agroforestry system once the trees are introduced in the agriculture system. The agroforestry system improves all the parameters of air quality, manage underground water, below ground carbon storage, provide habitat for animals, recycle oxygen and conserve soil and water. He also presented few prominent examples of the agroforestry systems.

Besides addressing the global examples, he elaborated the benefits of agroforestry to small and marginal farmers. When a desirable multipurpose tree species or tree component is introduced in the agriculture system, the system moves very differently. The productivity and net return of the system are enhanced as compared to the monoculture and was discussed through the benefit-cost ratio. In addition, in the present time of climate change when there are some failures of the crops, at least the farmer is assured that he will be getting some return from the tree component. It is not only the above ground biomass, but the agroforestry interaction increases the soil fauna also. He presented a few examples which clearly indicated the increase in the belowground soil fauna through introduction of a tree crop component in the system.

Dr Dhyani highlighted the challenges that were being faced in the present situation especially in terms of food crisis. In the short- to medium-term perspective, during the prevailing COVID-19, there has been a food crisis to a greater level. From the long-term perspective, all these global trends were going to be similar to those in the present-day situation *i.e.*, demography, the climate change, natural resource degradation and loss of biodiversity, *etc.* If these trends are not reversed, then food and nutrition insecurity can progressively deteriorate the nature.

Commonly when agroforestry is referred, most of the policy planners and other people think only in terms of timber and pulpwood, but at the farmers' level, there will be different benefits apart from timber and pulpwood. The small and marginal farmers are deriving benefits by introduction of the fruit plants with short rotation. He gave example of guava and especially the improved varieties which start fruiting from the second year only and also papaya. These trees enhance the nutrition content of the food basket.

Agriculture is presently responsible for 2/3 of terrestrial emission of nitrous oxide but if we can manage the soils then it can be reduced to almost 2/3 of agricultural emissions with good management and interventions.



The land degradation is a challenge not only at global level but also at regional and national levels. Figures may vary from 40% to as high as 46% of land degradation affecting agriculture and other areas.

Fortunately, agroforestry helps in this endeavour. The introduction of tree component along with the perennial grass and other components in a scientific manner, with interventions of natural resource management aspects will definitely improve not only the soil physical, chemical, hydrological property but also the vegetation in the long time which ultimately will enhance the income of the communities who are dependent on those common property resources

He also referred to biofuels, tree-borne oilseeds (TBOs) which are emerging as an important alternative to replace the fossil fuel e.g., Simarouba, Pongamia, Mahua, and Neem. In fact, in India and neighbouring countries, there are good examples where this biofuel energy integrated with food-energy systems is functioning well. Introduction of multiple species at least ensures round the year supply of food stock. In addition, the livelihood improvement and the potential greenhouse gas (GHG) savings are there which need to be scaled-up and scaled-out.

Special reference was made to COVID pandemic situation. Though most of the countries had emerged from this yet in some of the countries, this was going to affect in the long-term — the migration and reverse migration. But there had been a silver lining also as the reports had been coming that the COVID-19 virus warriors and farming community had been so resilient that at least the impact of the all those worsening things has not been reflected in agriculture sector as it has been affecting other sectors.

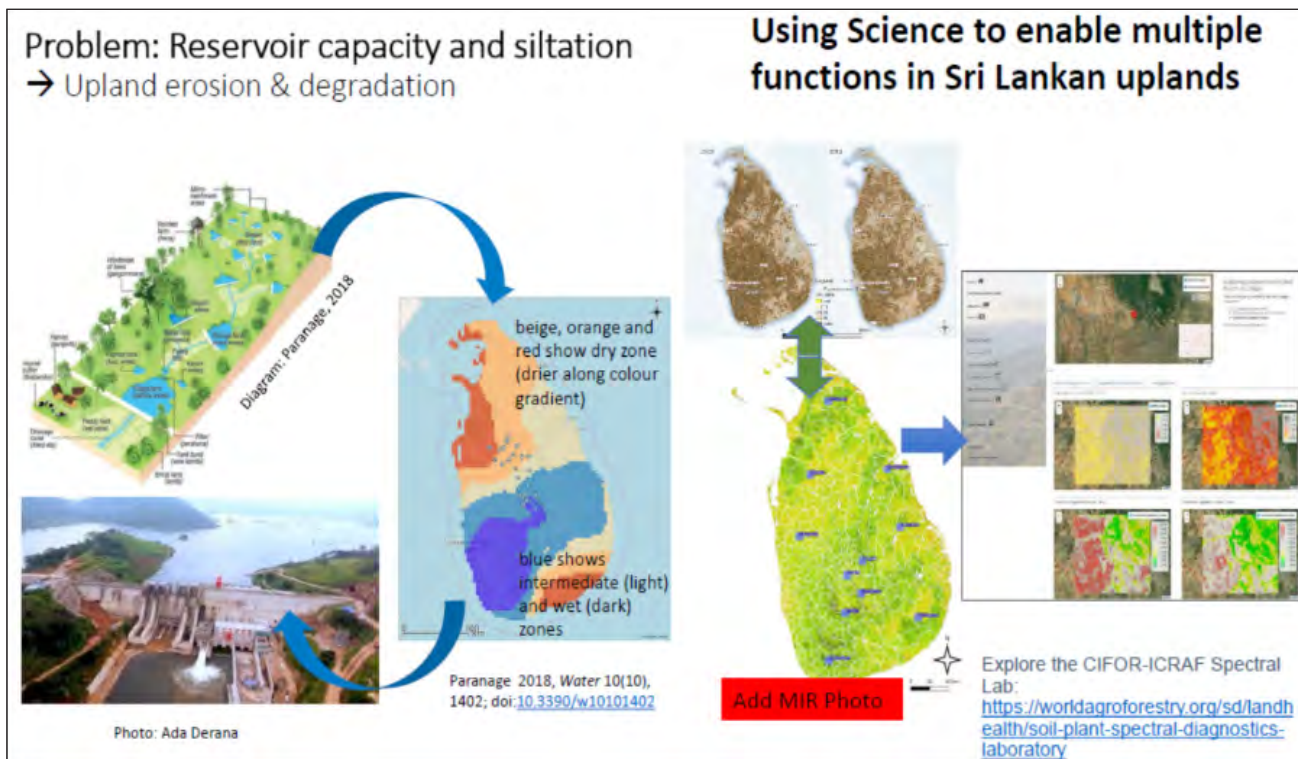
He emphatically stressed that if we had to promote agroforestry, then we must have the local examples and develop the working manuals, so that they were available to the farming community and other stakeholders. “Agroforestry in rice production landscaping in Southeast Asia” — an example of a practical manual but similar efforts were needed in every country of this region.

Although, the aspect of water use efficiency was to be dealt by another expert speaker but Dr Dhyani specifically mentioned the relationship between the number of the trees in degraded land, the improved canopy and the infiltration in ground recharge relative to canopy. Introduction of trees on the bunds and boundaries not only provide the food and other products but also improves the water retention and infiltration. As a result, the water is available for the next crop available in addition to the natural conservation when normally the farmer does not take the second crop.

One of the problems with most of the countries is that the extension agencies those do not have much capacity or facility, mobile-based application especially in the regional language will provide all the information on the system approach, crops, plants and best management practices. In addition, the availability of the quality planting material is an important and essential key for the success of agroforestry. Information can be provided on the Application (App) itself about the location of the nursery.

He also quoted example of introduction of trees in agricultural landscapes for delivery of ecosystem services in China where almost 28 million ha of degraded land will be brought under the agroforestry in the long run. It has not only rehabilitated the degraded land but has also reduced the soil erosion, flooding, and enhancing local economy. This example can be followed by other countries also that how the degraded land can be converted to a good land use system of agroforestry.

Another initiative to be undertaken in most of the countries is on tree crop improvement work, to augment the supply of the quality planting material especially of the indigenous species. Another example shared by Dr Dhyani was the use/introduction of modern science tools and procedures — spectroscopy developed by ICRAF and tested in Africa and later on introduced in Southeast Asia. Example of Sri Lanka was also shared where they are using technology to assess immediate soil improvement. This technology has also been tested in India and validated for the last 6 years and now it is ready for up-scaling also.



In addition to that, even the new innovations are happening where the agroforestry-based Agri Voltic Moringa, other small and important trees, bushes can be planted. Now the farmers are assured to get the electricity provided by this system in addition to the by-products from the introduced tree components and the nutritious crops also. This is very important where the malnutrition and the problematic soils are the issues. This will also be an important tool for enhancing the income of the farmers.

He concluded his talk with the comments that agroforestry can meet the challenges of food, nutrition, fodder, timber, pulp, industrial and medicinal products, energy and carbon sequestration, soil rehabilitation, water conservation, biodiversity, employment and livelihood generation. However, a new paradigm is to be considered in inter-sectoral planning and policy in each country to practice agroforestry at a scale leading to transformative impact. Another aspect imperative to achieve the above set objectives is awareness and capacity development of all the stakeholders (policy makers, researchers, practitioners, development partners, farming communities and private sector).

Topic: Agroforestry: Innovations and Public-Private Partnerships

Speaker: Ravi Prabhu, CIFOR-ICRAF

Dr Prabhu started his talk with a comment that “The agroforestry itself is the bundle of innovations that we had over thousands of years. All agriculture was agroforestry until 19th century with some exceptions but essentially farmers combined trees, crops and livestock — traditional agroforestry, until the so-called modernisation of agriculture took place when ways parted. What has been heard today is that those parting ways are again coming back together.”

He briefly talked about the need of innovations not only in agriculture but also in agroforestry. The big innovation that we had in the 1960s and 1970s was the green revolution and all the technologies that were delivered together with, as we know particularly in Asia, it fed Asia and most of the world. But today when we see across green revolution at landscapes where the intensive green revolution has taken place, those soils, the water and even the air is in need of restoration. At the same time, it has been observed that yields are stagnant or even declining. So green revolution as an innovation or a bundle of innovations may have run its course. The extent of indebtedness of farmers has gone up mostly in India and in many other countries as well because of the high input cost and also as consumers’ nutrition values have not been kept up to the expectations. So, it is also to be recognised that the need for innovation comes from the fact that our contexts are extremely varied from country to country and within a country as well. The socio-economic systems, political, legal institutions even within a single country can be very different. So, we have to be enabled to make certain that each innovation is contextualised.

He further elaborated that we all are facing the global challenges as addressed by a number of speakers which are driving the changes faster for which we need to maintain the pace. In fact, we are called upon to adapt constantly but he was of the opinion that we don’t think about adaptation as a process that is developed in our labs and then passed onto our farmers but rather adaptation is a continuous two-way or multi-way process of conversations about new ideas that can come from the bottom-up rather than the top-down approaches. It can come from smallholder farmers, large scale farmers, cooperatives, farm associations as just as much as it can come from researchers in our labs and research institutions.

He referred to an example that was particularly interesting in the context of the Conference of Parties to the UN Framework Convention on Climate Change which was to take place next month in Glasgow. That was related to the distribution of greenhouse gas sources in the agricultural sector, which provides estimates 20% to 25% and some even higher of all greenhouse gases. We had to accept that we are contributing to some of the problems quite largely, in fact, not just in climate change but in other areas as well. He opined that of course livestock and for farm fertilization, use of synthetic fertilizers is a major source. It is well-known that rice and its methane emissions cause a lot of the greenhouse gas emissions and land use change is

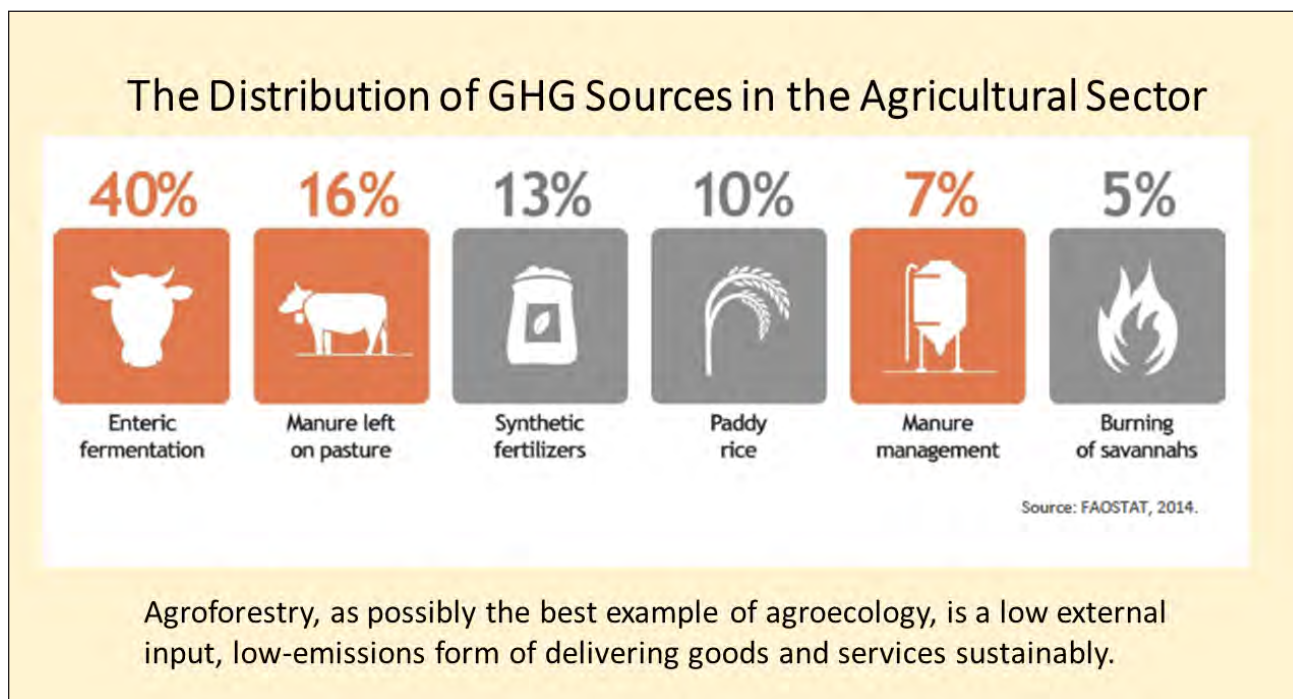


Ravi Prabhu

Ravi Prabhu

Deputy Director General (Research) and Director Innovation, Investment and Impact CIFOR-ICRAF

Ravi is serving as Deputy Director General (Research). He has served on numerous international initiatives and committees, including the Millennium Ecosystem Assessment where he served on the review and editorial team, and the UN Millennium Projects Taskforce 6 on Environmental Sustainability. He received the Queen’s Award for Forestry at Buckingham Palace in 2005. Ravi was previously a Senior Programme Officer, Forests and Climate Change with the United Nations Environment Programme (UNEP) in Nairobi. He led the UNEP team that contributed to the UN-REDD Programme – mainly by supporting countries to realize multiple benefits from REDD+, and to use REDD+ as a catalyst to transform to a green economy. Ravi Prabhu has engaged in multi-disciplinary research and action in forested landscapes for almost 20 years.



another source of greenhouse gas emissions. In all of this, permaculture, agroforestry and the kinds of context adaptive systems that are being discussed in this meeting were being a major source. In fact, as pointed out earlier also, they can be a mitigating influence as well as an adapting influence on climate change. He was of the opinion that if we start applying agroecology and agroforestry, we can actually get a win-win situation for climate change in terms of both mitigation and adaptation at the same time and that is why innovating within agroforestry makes sense.

Most of us have come to our work through the public sector in one way or the other. So, he focussed mainly on the important role of the private sector. Generally, corporate sector is considered as private sector but even a smallholder farmer is a member of the private sector. He again emphasized on the point that the changes hitting us globally are also hitting us locally, though do not always look the same. The private sector, small and large, drives a lot of this change through its demand for products and the market supplies. He mentioned that when I was doing my early research in Kalimantan, Indonesia, oil-palm was rare. It was all about wood production and forest being cut for essential plywood production and then it was about paper and pulp and now oil palm. The way these land areas and forest areas are used, drove a lot of changes in the systems.

Private sector has an enormous role to play especially because of its investing power. The large-scale companies *e.g.*, Syngenta and Monsanto are the big bankers in the field of agriculture, the companies that deal at the retail as well as whole sale level. Most recently, the roles of technology are the key players in the political economy of decision making *i.e.*, what kind of activities in the agricultural research and what kind of impacts these have on our innovation ecosystem? When we look at innovation, it cannot be just about what we are trying to do in our research labs, it has also to be about innovating around the value chains, the kinds of products we have but much more importantly how those products are delivered. We can choose to have products in monocultures or in mixed permaculture systems like agroforestry. The innovation then is how do we make those systems economically viable.

The point was illustrated with the help of pictures from various parts of the world, from India especially near Jhansi where some experiments in hydrology were conducted in that landscape. Dr Prabhu mentioned that in the past, entire landscapes have been changed not only in terms of the monoculture but also even in terms of agroforestry systems. A number of Indian forestry timber systems had been saved, in fact, by

an agroforestry system called Taungya, which came out of traditional systems that was practiced in Burma and then adopted to regenerate forest. With the kind of prevailing agroforestry systems, we may not have a successful timber industry around teak from the late 19th century onwards. For fruits and fibre, we had been constantly innovating this part of the system and innovation had not always been from lab-to-land. The expansion of commercial agroforestry was driven by the demand concept of commodities. It was just about the commodity produced as cheaply and as efficiently as possible, ignoring for instance the mode of production where you must have the diversity of species. Thus, we have monoculture coco, also called full sun coco. Majority of coco, which is produced in West Africa, is traditionally grown as an understory species which thrives under shade. These choices are being reversed now in West Africa as cocoa production is being challenged in West Africa which needed innovations. During these innovations, the impact on the welfare of local communities and farmers has not been taken into consideration consequently farmers turned into farm labourers. In fact, agriculture is treated as an agricultural production factory instead as a land management and stewardship system. It had been often the demand stipulated system. As an example, Sri Lanka initially was a coffee growing country until the blights hit the coffee and it shifted to tea. Basically, nobody really thought about what would be the best plantation crop in the highlands of Sri Lanka! Shifting from coffee to tea cultivation, is now being challenged in Sri Lanka and now a better innovative system of management of the highlands is under consideration.

He concluded his presentation on the importance of agroforestry, which being a mixed species system allows us to layer multiple products and services on top of conventional commodities on the same piece of land. In addition to commodities, one can think about carbon, phyto-remediation of mining sites and land restoration, nutrition, energy, water,

Examples of innovation with public-private sector engagement – the past

- Much of what we recognize as large-scale commercial agroforestry today is a result of innovation with private sector engagement along with govt. investment and enabling policies
 - Cocoa, coffee, timber, various fruits and even fibre
- This expansion in commercial 'agroforestry' was driven by demand for these commodities, but tended to ignore:
 - modes of production – e.g. diversity of species used
 - Impacts on the welfare of local communities and farmers, often turning farmers into farm labour
 - Impacts on ecosystem services
 - Alternatives for those sites – leading often to large scale failures (e.g. coffee preceded tea in Sri Lanka, until the former collapsed)

climate recreation in ecotourism, health and well-being — all from the same site. Agroforestry is a huge sink and source for knowledge and creativity. It is important to be clear about how things are produced not just what is produced. These kinds of mixed systems are more resilient and, therefore, we need to have a greater potential for the kinds of innovations. New matrices are being developed for measuring the success; in future, success will not just be measured by the return on investment but by the total costs of production and the resilience and sustainability. One of the concrete examples is mix species horticulture in Bangladesh, an innovation to deal with some of the problems of the periodic flooding. New approaches such as natural farming, regenerative agriculture and forms of permaculture, all intersect now with in agroforestry. Agroforestry is the bundle of innovations that our ancestors developed over thousands of years to manage trees, crops and livestock in some kind of synergy. The biggest new area of innovation is trying to develop patient and variable capital at scale to support and de-risks such transformations like green climate fund — one of the big commercial funds.

Topic: Agroforestry and Water for Resilient Landscape

Speaker: Ramesh Singh, Principal Scientist (Soil and Water Conservation), ICRISAT

Dr Singh made presentation on “The Agroforestry and water for resilient landscape” on behalf of his other colleagues from ICRAF, ICRISAT, IGRI and CAFRI. Basically, the focus was on major issues in dry lands with examples from Bundelkhand, India and lessons learnt from research experiments.

The major issues identified specially in Bundelkhand region of India are water scarcity, mid-season drought and dried-up wells in *Rabi* and *Kharif* season. In spite of about 800 millimetres rain, there was no water availability, especially October onwards because water holding capacity of the soil is very poor which is a major challenge. Besides being rainfed region, about 30% to 50% of the land is fallow, poor water availability, poor productivity of crops and livestock, less permanent vegetation cover and wide range of fodder scarcity. These were the issues supported from the data collected from different districts of Bundelkhand region of India. Drought proofing of the system can be done by integrating the two technologies — agroforestry and natural resource management.

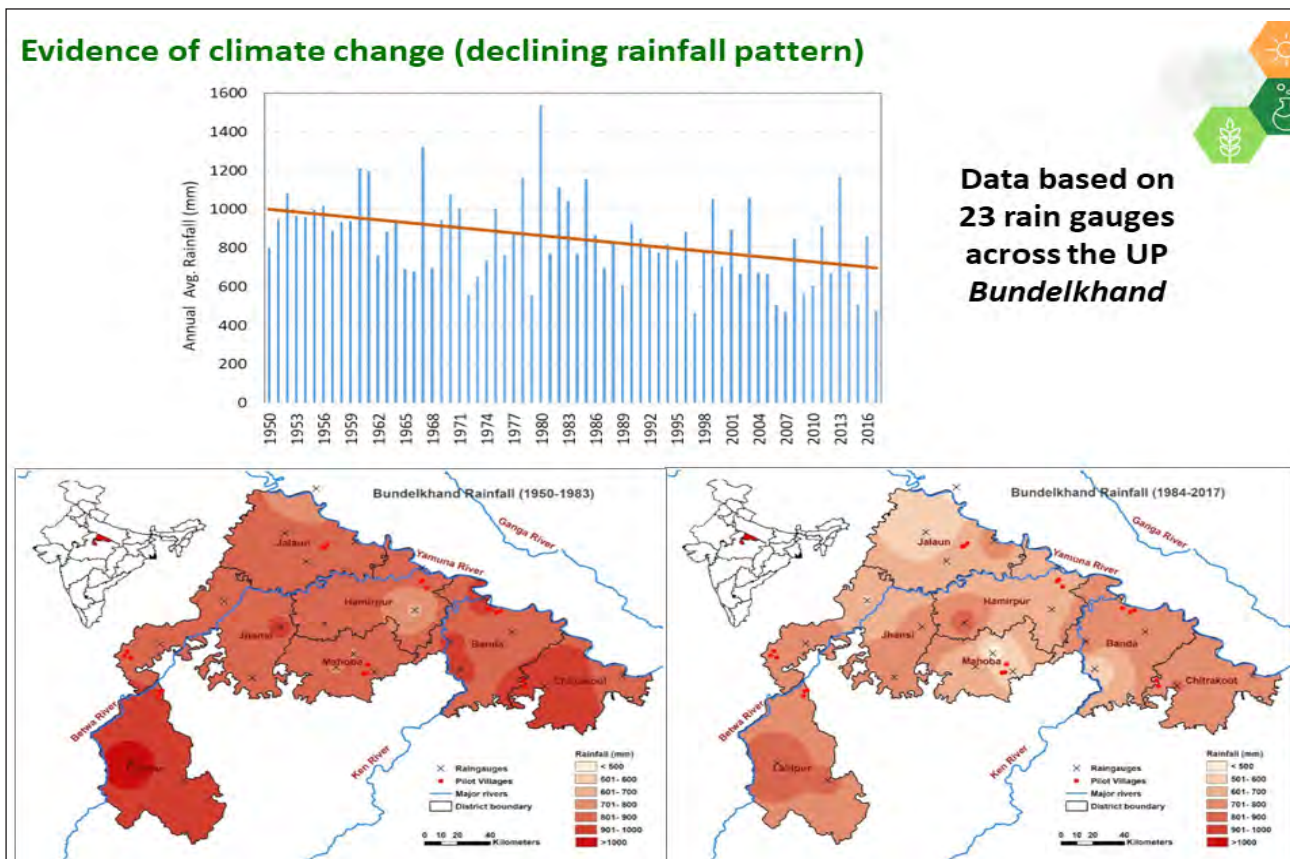
A small experiment conducted at experimental farm of Indian Grassland and Fodder Research Institute (IGFRI), Jhansi, where 5 treatments were taken with a control and contour staggered trenches, continuous contour trenches, deep basin (stone mulch) and vegetative barriers treatments.



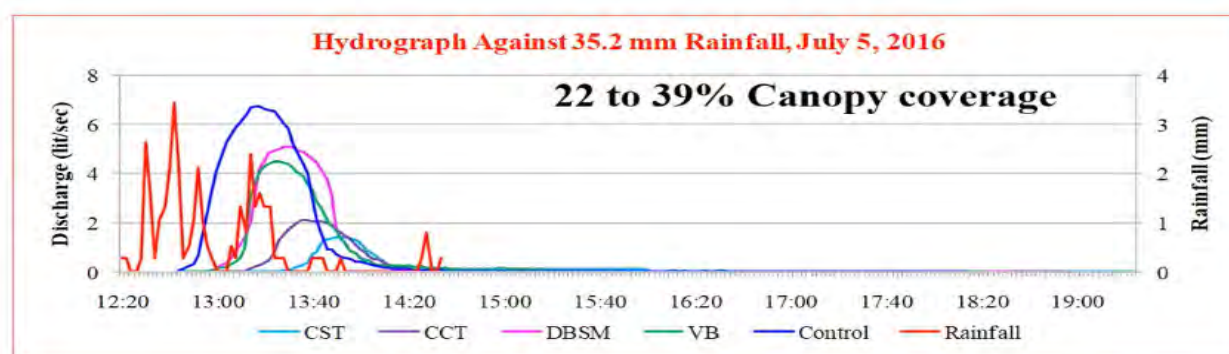
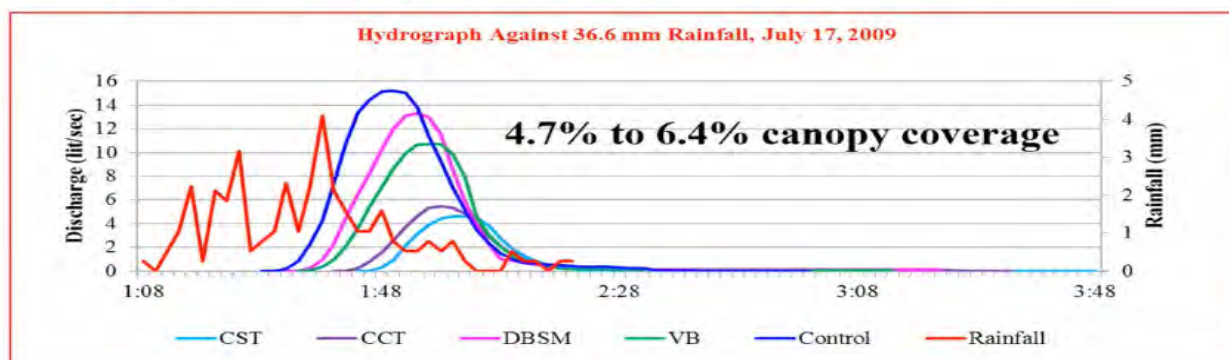
Ramesh Singh

Ramesh Singh
Principal Scientist
Soil and Water Conservation
ICRISAT, India

Dr Singh is the Principal Scientist of Soil Water Conservation with ICRISAT in Hyderabad. He is an expert in watershed management especially with agroforestry intervention on hydrology and nutrient loss management system. He has done award winning work with water bodies management in central India for the past 20 year.



4.6 to 6 times increased canopy reduce peak flow by half to one third



Dynamics of surface runoff varies with the rainfall and enhanced base flow. This experiment was started in 2007; plantations were done in 2007 itself and were monitored till 2016. Comparison of control and contour trenches revealed that in 2011 and 2013, rainfall was almost the same but there was a difference in the runoff as shown in the graphs. In 2013, the difference was about 70%. The only variable was the permanent vegetation supported by the contour staggered trenches. Difference in the runoff (about 20%) recorded was due to the influence of vegetation.

Another set of the data were taken in 2009 and 2016 was discussed. Under only 35 mm rainfall at both the situations and with the similar intensity. In 2009, permanent canopy cover and vegetation cover was 5% and 35% in 2016. In 2009, when the data of control vs contour staggered trenches was compared, the runoff and the discharge of water in the control plot was 15 L/second and in the contour staggered plot, it was very less around 4 L/second. Later in the year 2016, in the control plot having same treatments except the permanent vegetation cover which had gone up by five-fold, the discharge had been declined from 14 to 7 L/second whereas in case of contour staggered trench, it had declined to 1 and minimum 80% decrease in the discharge of the runoff could be seen. Second result which could be inferred was that after the decrease in the rainfall, the flow could be noticed up to 2 hours in 2009 when the permanent cover was only 5% and in 2016 it had gone up to 7 hours. The similar experiments were also conducted in the watersheds and in all these experiments, it could be concluded that woody perennials and agroforestry significantly enhance the water content and water holding capacity of the soil. Now to enhance the water availability in the region and to conserve the water in the rainy season and to bring sustainability, there is a need to club the two technologies of agroforestry and NRM together. At ICRISAT level, it has been decided and wherever this activity is being scaled-up in different states of India, two technologies are combined to bring resilience or sustainability.

Another example shared by Dr Ramesh of scaling-up of agroforestry with NRM activity was at a field level or village level with the support from Department of Agriculture, Uttar Pradesh, India, having around 100,000 population and a landscape of 30,000 ha spread over all the seven districts in 22 villages with around 24,000 households. He mentioned that without landscape NRM interventions, field scale activities cannot be taken place. The sustainability can only be brought by starting the activity at landscape followed by the field scale activity.

For enhancing resource use efficiency and at landscape level, resource management interventions were demonstrated with around 6000 interventions along 6000 field bunding, 1000 laser levelling, masonry structures and *in-situ* water conservation through *Havelis'* technology approach — a traditional technique followed in India and originally evolved in the Malwa region.

As far as climate resilient field scale activities were concerned, they were based on the concept of agroforestry. In agroforestry interventions, timber-based, fruit tree-based and homestead agroforestry for household nutrition security were undertaken from 2019-2021 in which more than 350,000 tree saplings of various categories were planted in more than 3000 farmers' fields. Digging of pits was done technically with machines with 70 cm dia. and one meter depth as in red soil there is no difficulty but in black soil there is a lack of internal drainage for which, sand and manure was added. Another technique used was that of budding in which more than 5,000 *ber* (*Ziziphus mauritiana*) trees were budded during monsoon season in the Bundelkhand region. *Havelis* system of land use was explained with an example from Village Lalitpur in UP, India. Out of 250 ha, only 4 to 5 ha was developed under this system by making trench with raising of the forewall in the trench as shown in the picture (below) and to give support, soil cover was given over it under this technique. To drain out the water a specific structure was also developed as shown in the slide. Farmers harvest water in this system and they collect water in the rainy season and the water will remain there for four months, so that the ground water gets re-charged. After four months, they can drain out the water in the month of

Renovation of *Havelis* : Bringing a lost tradition to life



DFI UP Bundelkhand project: Birdha village, Lalitpur district, UP

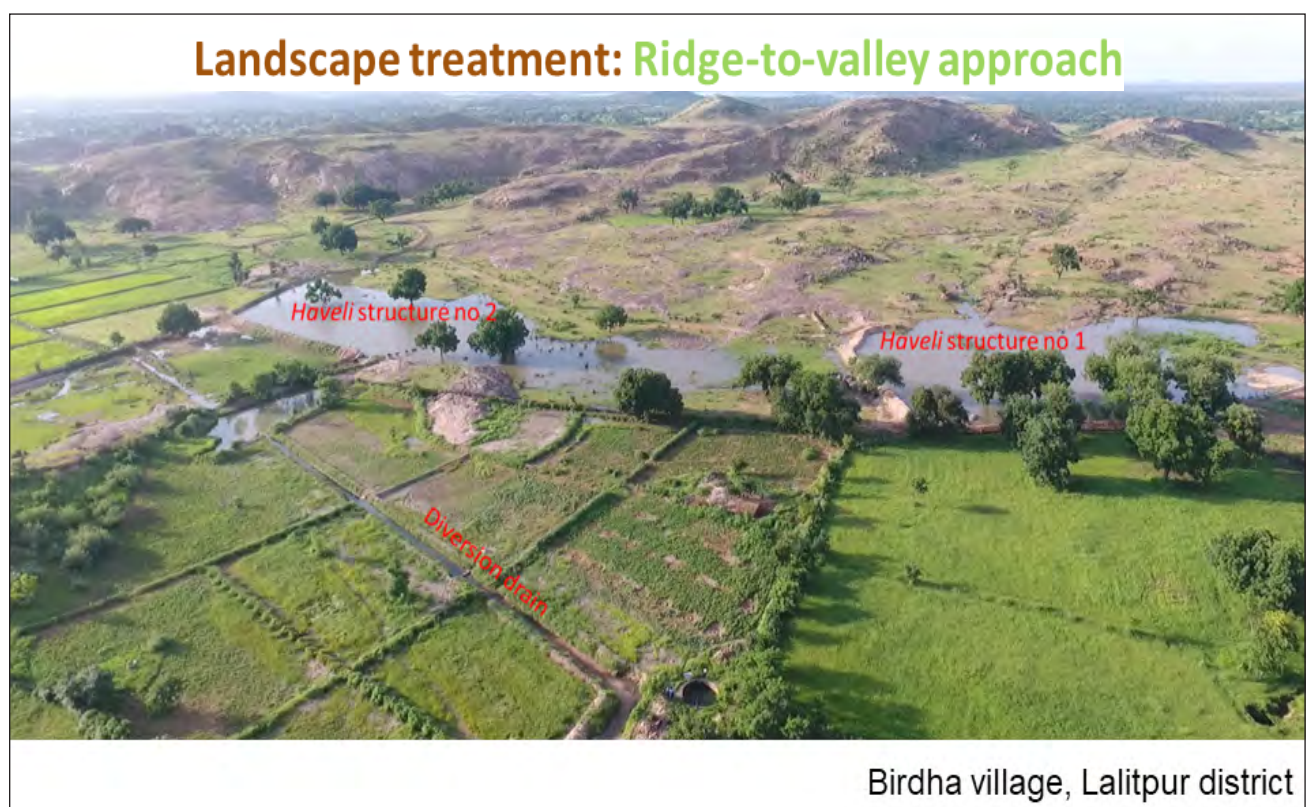
October for 10-15 days for cultivation of the next crop and by that time, the temperature comes down and with residual moisture, the farmer grows wheat crops, etc. Economics of cultivation of single crop was more than that of having two crops in the season. With this technique, in lieu of having single crop farmer ensured not to have flood irrigation but ensured to have water for the community. They ensured three irrigations for the non-interested farmers, ensured their soil fertility, reduced soil loss or whatever sedimentation of the upper layer to be retained there.

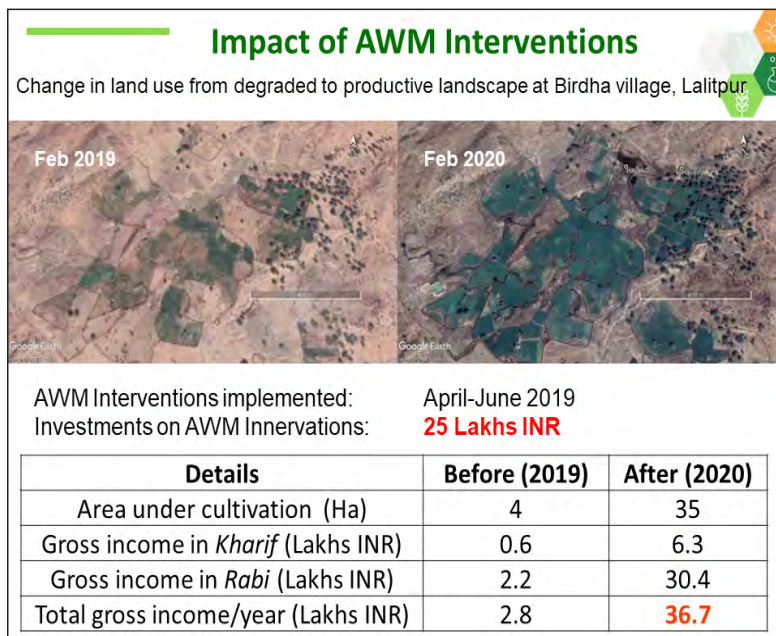
The whole case study was depicted and discussed through slides and it could be seen that the area was a complete barren land for the last around 30-40 years and except one family of two person, no one was living in this land. Now 50 ha of the land is rejuvenated and has led to the construction of five *Havelis* system.

He also showed the pictorial views of the impact of this intervention — change in land condition, water management, total area under cultivation increased from 4 ha to 35 ha in the region and gross income in *Kharif* from INR 0.6 to 6.3 lakhs and from INR 2.2 to 30.4 lakhs in one year with the project intervention of INR 25 lakhs only. The earning of the families had increased around ten-fold after one year of this intervention. All the field bunds of this landscape of 250 acres were having mainly the bund plantation of teak (*Tectona grandis*) or neem (*Azadirachta indica*) and some of the area was under fruit-vegetable based agroforestry system.

The integration of NRM and agroforestry helped to build system level resilience. There was 60% to 79% more recharge in the treated to untreated system of NRM agroforestry. It was realized that even having a 30% deficit rainfall, there was an increase of 4% to 6% and there will be enough water for at least 10 months. If base flow is improved from 1.5% to 4 % then the whole area can be made fully arable.

He concluded his talk by discussing the impact of this technology of combining both NRM and agroforestry interventions, demonstrated in 40,000 ha where it reduced the risk of crop failure for about 10,000 farming families by enhancing groundwater and soil moisture availability. Improved crop cultivars along with the best management practices enhanced crop productivity by 20%-40% as compared to control conditions, reduced the cost of cultivation by INR 8,000-10,000/ha with increased groundwater availability and reduction of





labour requirement without any water pumping cost from the wells. It also reduced local wells recovery period from 30-50 hours before to 10-15 hours after the treatment. With improved groundwater availability for agriculture and domestic use, drudgery particularly of women and children was reduced considerably. It also increased crop intensification from 110% to 170% and enhanced income of farmer by 40% to 140% as compared to the baseline status. Even the fodder availability had improved from deficit of 50% level to surplus level. This also helped in reducing the out-migration from the system.

After presentation of Dr Ramesh created a great interest in the participants who raised many questions and queries by the participants, which were addressed by the speaker, Dr Shiv Dhyani and also by Dr Javed Rizvi. Dr Shiv Dhyani added to the comments made by Dr Javed Rizvi that Mobile App, though, has its limitations of network yet it is a new emerging innovation and especially at this stage, it is a very good tool in the hands of extension workers. Similarly for the availability of quality planting material there is a need to establish entire system from nursery accreditation to certification. Like in India for horticulture, it has been well-taken care and that is why quality fruit planting material is now available. Similar efforts are being done in case of bamboo and other agroforestry trees.

As Dr Subhash informed that ICRAF have submitted a major project proposal for expansion of trees outside forest in India to USAID. Certification of trees outside forest including agroforestry trees is fairly important to enhance climate resilience, livelihoods, value chains, *etc.* One aspect that is pertinent to mention here was that a high-level committee on agriculture exports constituted by the 15th Finance Commission of India had assessed that some 72% of wood-based requirements are met from trees outside forests. Only 5% is met from the forest areas and 23% is met from the imports. In this context, certification of agroforestry trees is fairly important. So, there is a need to identify best possible mechanisms which are simplified and directly helpful to the farmers who are not able to afford the cost of certification. In India, group certification has happened using some schemes by major paper mills. Recently the Department for Promotion of Industrial Internal Trade had identified furniture as a focus subsector for augmenting availability of certified raw materials. It is worth notice that when certified raw material is not available, so many multinationals are trying to set up their furniture units in India. So, the issue has been very well raised by Ministry of Commerce to the Ministry of Environment, Forest and Climate Change and there is a proposal to evolve proper timber policy which addresses various aspects of export, import of timber and certification, *etc.*

Concluding Remarks of the Session

Dr Ravi Prabhu, Chair, concluded the session by conveying his thanks, as most of the questions/queries raised by various participants were addressed by the speakers or experts. Dr Prabhu thanked all the speakers, experts and the participants.

Dr Rishi Tyagi thanked the chair Dr Ravi Prabhu for conducting the session, very ably and efficiently. In response of the requests of participants for sharing the presentations, he also made it clear that with due permission of the speakers, presentations will be posted as a resource on APAARI's website and link will be shared to meet the request of participants.

Session 2: Enabling Policies and Scaling-up Investment in Agroforestry

Session Co-Chairs: S Bhasker, ICAR; Javed Rizvi, CIFOR-ICRAF

Rapporteurs: Archana Singh, CIFOR-ICRAF and Sunil Londhe, CIFOR-ICRAF

Dr Devashree welcomed the participants to the second session and introduced the speakers of the session by giving brief background detail of each speaker along with the brief introduction of the Co-Chairs of the session.

Topic: Need and Value of Policy: Learnings and Expectations from Policy and its Implementation

Speaker: Javed Rizvi and Sunil Londhe, CIFOR-ICRAF

Dr Rizvi started his presentation with a question that why a policy is required and what is the benefit of having policy for agroforestry?

Agroforestry is multi-disciplinary sciences. He explained his point by discussing how agroforestry relates to different laws, policies and strategies in a country, referring to an example of Nepal. The relevant policies, rules and laws in the country were analysed and it was very interesting to observe that only 6% policies in the country were having no restriction or anything negative on the agroforestry, but 20% policies or the laws were putting some or the other kind of restrictions on planting trees in agricultural land scape or harvesting or transporting or felling. About 26% laws, strategies and policies were supportive to agroforestry. So, it is a very broad situation and then if we see how agroforestry is implemented at the district level then different government agencies have a role to play. This clearly indicates that in the current situation although agroforestry is popular in different countries but there is no particular ministry or department which is having a full-fledge mandatory management of agroforestry in the country.

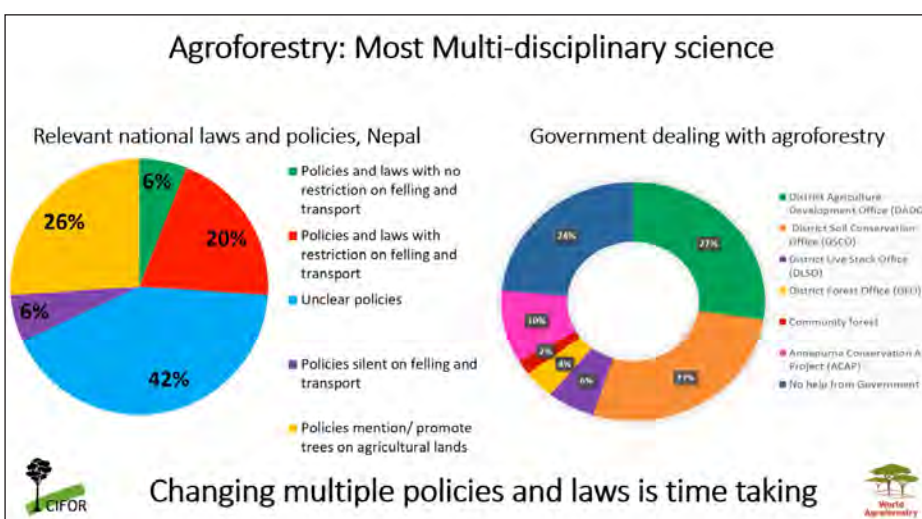


Javed Rizvi

Any functional policy can have a really large scale or transformative impact on the agricultural landscape. One typical example from India is that there were lot of restrictions on the trees grown on agricultural fields and those restrictions were also applicable to bamboo and then most probably in 2015-16, the Ministry of Environment, Forest and Climate Change re-classified bamboo, removed from the list of the trees and put

it as a recognised grass which was scientifically correct also. So, one intervention at policy level took away all the restrictions and hindrances created by the existing rules and laws.

Similarly, as Dr Prabhu mentioned about green revolution, white revolution and blue revolution, etc. If the government has supportive and enabling policies, laws



and strategies then things move very fast. If large scale impact is to be realized, then we should have some new technologies, new varieties, new methods and enabling policies to bring the impactful changes. It has been evident that the 33% of the land should be covered by trees, but the situation is not very good if we analyse the individual country's data and also the health of the forest. If it is seen through the lens of the carbon stock, it is reducing in Africa, in South America but luckily in Asia, Europe, North and Central America, it is improving. But the good part is, there is a significant increase in the area covered by trees outside forest. Asia is on the top among all the continents. Taking example of India again, during 2015 to 2019 according to forest survey of India, the tree cover of India has increased almost up to 2%, of which almost 1.8% is coming from trees outside forest. So that is the value and importance of the agroforestry and trees outside forest.

Everything looks like very promising and everybody talks about agroforestry but then there are challenges like while discussing the progress, Dr Rizvi discussed about the challenges also e.g. (i) no recognised body to coordinate agroforestry at national level, (ii) different kinds of restrictions through forest law and the other existing policies, (iii) problem of the availability of quality planting material, and (iv) no credit insurance policy for agroforestry. He mentioned that instead changing so many laws and policies which have been existing for several decades, the most practical way is to go for a separate and exclusive agroforestry policy to tackle all these challenges.

India became the first country globally, to have its National Agroforestry Policy during 2014 which was developed by ICRAF as a main contributor with other government agencies like Indian Council of Agriculture Research (ICAR), Central Agroforestry Research Institute (CAFRI) and other organizations. National Agroforestry Policy launched during the 3rd World Congress on Agroforestry. ICRAF is the only non-governmental organization which is part of the high-level inter-ministerial committee to oversee the implementation of the policy in the country.

Fortunately, the agroforestry policy picked up very quickly and the map shows that except a few states, most of the states in India depicted as blue areas (see figure on next page) have already implemented the policy (as agriculture is a state subject so federal government can formulate the policy but the implementation is with the state governments). There are recommendations to create a Ministry for Agroforestry and all agriculture related policies and strategies incorporate tree plantation in government supported programmes plus identify the agroforestry zone, including agroforestry for Corporate Social Responsibility (CSR) investments.

India is having a dedicated research institution for agroforestry — CAFRI and initiating the implementation through establishing an agroforestry mission. A lot of these recommendations have already been taken into account and implemented. Agroforestry mission is like a large-scale project to popularise agroforestry and the government invested almost \$150 million. A similar programme was created with bamboo with almost \$200 million. And then a very special incentive for mechanism to encourage state governments to increase their tree covers. If a state is having more tree cover, the federal government will get more money to back that particular state.

Currently in India, 70% need of timber and almost 70% pulp requirement is met through agroforestry and similarly overall 60-70% plywood industry is fed through agroforestry. These are some of the very significant

Javed Rizvi

Director Asia and Regional
Coordinator South Asia
CIFOR-ICRAF, India

Javed Rizvi is an Agricultural Scientist with a broad experience of working on national agricultural policy, research-for-development strategies, and advocacy-related issues. He has managed several large multi-disciplinary agricultural programmes including aspects of research, extension, technology transfer and capacity development, all aimed at improving food and nutritional security, diversification and intensification of crop-livestock-silviculture production systems, soil-water conservation, alternative livelihoods and small-scale processing and marketing of agricultural and forest products through community-based organizations. Dr Rizvi has served as a visiting scientist in Italy, Spain and the USA and has published over 50 research products.

Salient recommendations of the policy



- **Mainstreaming agroforestry in agriculture policies and strategies**
- **De-notify tree species from felling, transit and processing regulations**
- **Incorporate tree plantation in government supported programs**
- **Identify and demarcate clusters (area) to be free from above regulations**
- **Link producers with industry and development of value chain**
- **Endorse and facilitate CSR investment in agroforestry**
- **Guide production, certification and supply of high-quality planting material**
- **Facilitate lifting / relaxing the legal ban on sawmills in non-forest areas**
- **Promote research and development in agroforestry**
- **Promote public private partnership**
- **Correct tree and land tenure**



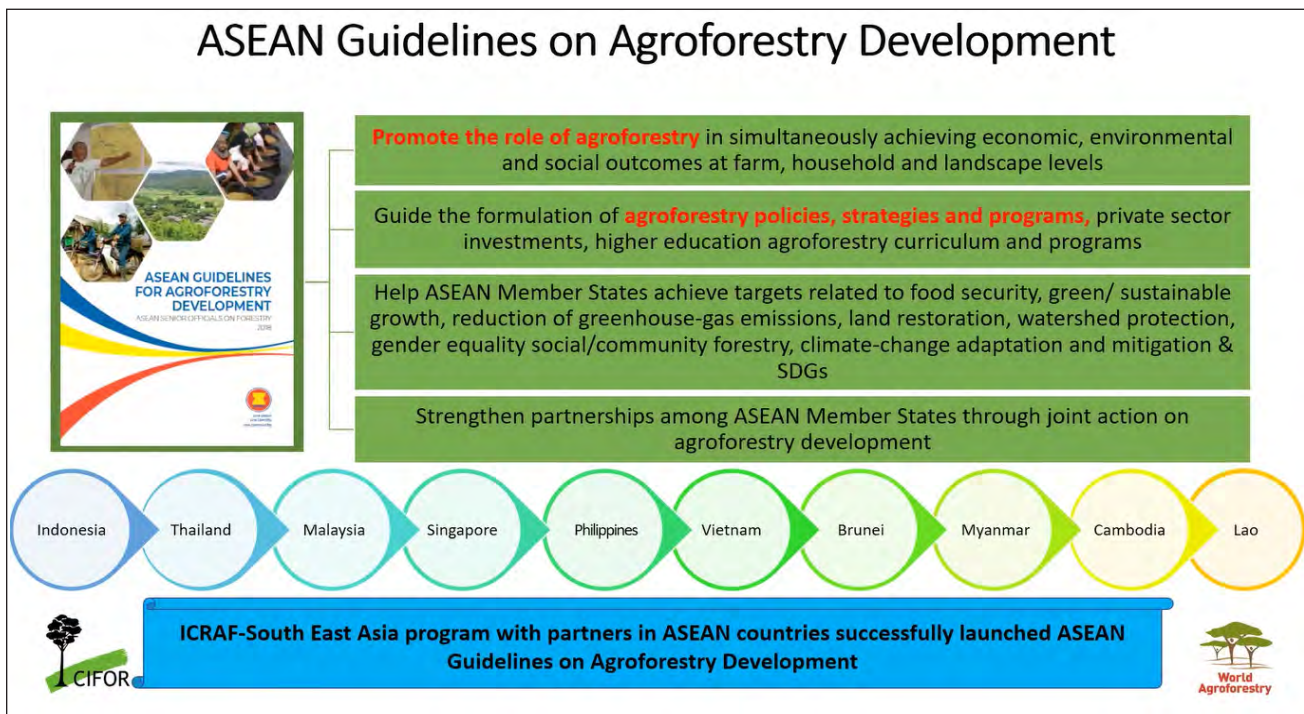
impacts having transformative effect on the smallholders, industry, tree related value chains, and also on millions of lives, being positively affected through enabled policy.

Indian policy was such an encouraging step that it had created ripple effect in other countries also. But having said that 70% in timber, pulp, plywood, etc. is coming from agroforestry, it does not mean that everything has been achieved. As mentioned by Dr Srivastava in the last session that still 30% timber is being imported and if we put a cost, it will come roughly around 8 billion US dollars or so. With all these developments, there is still a scope to increment agroforestry or trees outside forest at massive scale.

Dr Javed illustrated his point with the help of two very interesting examples. There are already roadside plantations in several countries and a quick estimation of roads in India reveal that there is about 70,000 kilometers road and if trees are planted at a distance of even 15 metres in one row on each side of the road, something like 9 million trees can be planted. In some places, it can be two rows also. Even most interesting is the case of the railway lines which are something like 5 million kilometers long and if trees are planted in a single row on both sides of the railway lines, something like 3.3 billion new trees can be planted. In every country, there is lot of degraded land, mining area and of course the traditional agroforestry where trees can be planted on the boundaries and as inter-crop. The policy is not the only instrument or the required step, we have also to work along with the technology transfer in science and other related things. He also shared the initiatives and conversation with Indian Prime Minister's office regarding how agroforestry can increase the day-to-day income of the smallholders.

The success of Indian policy encouraged the government of Nepal and there was a request to support the development of the policy. It took like almost 3 years' time and there were other partners like ICAR and CAFRI who were involved in the development of the Indian Agroforestry Policy. The National Agroforestry Policy in Nepal was launched in 2019 and currently it is in implementation phase. The importance of the policy has been recognised at the highest level and the President of India has appealed the state governments or the provincial governments to add agroforestry in all their agricultural schemes. Just like India, again we are privileged to be a member of the coordination committee on national implementation of the policy in Nepal also.

ASEAN Guidelines on Agroforestry Development



Another approach is that instead of individual country coming up with an agroforestry policy, the regional organizations are coming together to work out a strategy or planning code of conduct for how the agroforestry should be implemented in the countries of a region. He presented an example from 10 countries *i.e.*, Association of Southeast Asian Nations (ASEAN). India and Nepal are, of course, major players for the development of the guidelines of agroforestry for the 10 ASEAN countries — Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. As mentioned by Dr Dhyani also that like ASEAN, the South Asian Association of Regional Cooperation (SAARC) countries have also come together recognising the value of agroforestry and have planned to do a large agroforestry programme, involving all the SAARC countries. Currently, there are two countries who are working on development of agroforestry policy – Belize and Maldives. ICRAF is directly involved with Maldives and indirectly with Belize. There has been some interest shown from Bangladesh and Fiji to develop their agroforestry policies. Many countries are not actual believer of the policy but some kind of strategy, long-term plan, code of conduct are under preparation at one or the other stage which is a clear indicator that how the success of Indian Agroforestry Policy has created the interest globally. He concluded his talk with the remarks that even if we have wonderful scientific proof, information on policies, agroforestry systems, nurseries, quality planting material with the people, still enabling policy will play a major role in promotion of agroforestry. He ensured the delegates that his team will always be happy to collaborate and support any Asia-Pacific country that needs a good plan, strategy or policy on agroforestry.

Topic: Innovative Strategies for Scaling-up Investment in Agroforestry

Speaker: Helen Wallace, Griffith University, Queensland

Prof. Helen made her presentation with a note on agroforestry in a different geographical situation in another part of the world but with similarity of experiences in terms of opportunities and challenges for agroforestry. She had been working for most of her last 15 years in the Pacific region in the countries Papua New Guinea, Fiji and other Pacific Island countries. It was mostly ocean and this was a particular challenge for their work because many of the communities that they work and live on very remote islands. They had growing populations and had great difficulties in getting their products to market due to non-availability of boat on island, cyclone or storms, etc. These communities do not have access to education, healthcare, medicine, transportation (no roads) on the islands and they rely on the boats. Among these communities, there had been a lot of timber harvesting and in some cases, some unsustainable timber harvesting also. Losing the natural forest was causing a major problem of environmental degradation.

Since 2006, Prof. Helen worked with a series of agroforestry projects with Australian Centre for International agricultural research (ACIAR) and in partnership with other donors in the Pacific region. The projects were focused on agroforestry as a way to put trees back into the catchment, to improve the livelihoods for smallholders especially for women and with a special focus on value addition. She mentioned that need of the hour was to find ways to preserve the produce so that it can be stored and can have a long shelf life, to get access to more distant markets. The projects were aimed at to empower smallholder women in particular with the main focus on a range of indigenous nut and fruits species.

She very clearly pointed out that it was important to know what did not work rather than what worked so that we can learn the lessons. In all the countries she had worked, there was a lot of recognition from donors and from governments about the need to put forests and trees back into the catchment, to preserve the environment, to stabilize the soil, to prevent erosion and to preserve the fish stocks, etc. There were a lot of projects that gave millions of trees to farmers over a



Helen Wallace

Helen Wallace

Professor in Agricultural Ecology,
Griffith University, Queensland,
Australia

Professor Helen Wallace is currently Deputy Director of the Centre for Planetary Health and Food Security at Griffith University. She has been researching tree crops, including agroforestry, fruit, nut and timber crops for over 30 years, with over 100 publications. For the last 15 years, she has been working throughout the Pacific on agroforestry projects to improve livelihoods for smallholder farmers, especially women. She is trained as biologist, and now leads transdisciplinary teams that include social, agribusiness and scientific experts. Her current research aims to commercialize indigenous tree crops and increase women's income for their forest products.

What did work: Innovative strategies to scale up investment

- ◆ The power of the Market Pull!
- ◆ Our projects worked best when we empower processors and risk takers in the value chain
 - ◆ Partner with private sector
 - ◆ Food processors
- ◆ Need to understand social context
 - ◆ Major barrier is land tenure and customary ownership
 - ◆ Tree nurseries for donor projects
 - ◆ Wild harvest

long period of time. It was very difficult to find out that how many trees were planted and how many of them survived? Some of the smallholders still had the pots that raised the plant bags and they had not actually planted the saplings in the ground. Though the donors want to put trees back into the catchment, that simply is not enough reason and incentive for

smallholders to do the planting. On surveying and exploring the reasons, it was found that the smallholders were not planting the trees as they did not have confidence that there was an industry that would buy the products from the trees; only then it would be worthwhile for them to invest the time, the effort, the energy and to allocate the land that was needed for planting those trees. The second problem was that even the investors did not have the confidence that about establishment of any industry and the availability/requirement of a market for those products, processing of the products, cost of marketing and finally the profit.

Prof. Helen highlighted the studies from some other countries where they experienced not only a lack of entrepreneurs but also land tenure issues. Women were encouraged to plant trees and adopt agroforestry and the very first problem encountered was that women did not have the right to plant trees on the land because they did not own the land, and they needed permission from somebody else in the community, usually the chiefs of communities. In Fiji, for example, they needed permission to plant those trees and thus simply providing the trees free of cost is not enough as they did not have the social environment that would enable them to plant the trees. Furthermore, in countries like Vanuatu, planting a tree was a very controversial thing to do as what they believed that when you are planting trees, you are actually making a land claim and that was the source of many disputes at the village level. These major constraints were faced while working with these communities for practicing agroforestry in the country.

Considering the marketing constraints, a market-oriented approach was adopted. Prof. Helen categorically mentioned that availability of markets being a barrier for people to invest, it can be called the power of market-pull when they started with the market and empowered people along the value chain in partnership with small, medium and large private sector; in some cases, who will join for food processing in their countries to empower and help the pool of women to plant the trees and process the products for marketing to enhance their income. Of course, the problem of land tenure was not an easy! The major barrier was the customary ownership, therefore, project team actually switched over to wild harvest.

In summary, we started with the production side what agroforestry crops can we produce; what is best germplasm; how can we select and grow it let us give it to smallholders and everything will be better. But that did not work. However, when we started with the other end, the market and the agroforestry products, what kind of market and the products required in the market, how big is the market and how people will pay



for it, what is this product competing with, it worked well by empowering risk-takers including smallholders to generate higher income.

Prof. Helen shared the success stories where some interventions made by women were discussed. These women basically bought the product from smallholders, usually their family connections or groups in society, processed and sold in supermarkets. The main objective of the project was working with the women and with other similar small- to medium-enterprises to help them with their marketing and processing the products.

Smallholders are also the private sector as mentioned by Dr Javed Rizvi and others, and similarly, are small restaurants. They worked with micro-enterprise women and trained them in pricing the product to sell in to the local markets to generate more incomes from the processed products.

Prof. Helen explained her point by citing an example of galip nut — an indigenous tree that grows in the Pacific. One of the reasons for selecting nuts for these countries and in agriculture development, in general, was that the nuts can be properly dried and stored which can be transported by boat taking long time (in a month) avoiding any urgency of immediate marketing. In addition, even if the smallholders were not able to sell galip nuts, it can be consumed and contribute to food security. There is a growing demand for nuts due to carbon emissions from, for example, animal-based protein. There is a strong push to plant-based protein and nut sector in particular growing rapidly all around the world. Global trade in nuts has increased rapidly in the last decade, because people want to have healthy plant-based protein. In spite of all the benefits of nuts, there are only 5 species that make up most of the global trade and many countries have indigenous nut species with potential but hardly any of them have been commercialised.

Galip nut is an indigenous tree that grows in the Pacific. It is also a high value timber tree as it produces nuts every year which have excellent nutritional value and one of the reasons to work on this species was because of the involvement of women. The team had a hope that by empowering the women in this value chain, because it was their domain, they would be able to increase their income. An ambitious goal was to set up a whole new nut industry when there was no industry before. When the industry was started, the only way to buy these nuts was through the women in the market who were selling these nuts afresh.

A demonstration factory was set up as it was needed to infuse confidence in the people that there was a market for these products. A product launch was done with packaged material and in the process all the science of processing was figured out. When this work was started, there was only one processor who was processing nuts at a very small scale but by the time the project ended there were 6 processors for value addition of the products with very strong market demand.

In 2014, in the beginning nothing was being done commercially but when the project finished towards the end of 2018, 232 tons of nuts were being processed in the demonstration factory alone. That was providing extra income to over 1,000 smallholders with a value of about 232,000 Kina/year. Just in a few years by using a demonstration factory in the project, a big impact could be made on the income and livelihoods of smallholders, most of which were women who were benefitted to a great extent.

In 2019, private sector started to invest and new industry worth about 300,000 to 400,000 Kina/year. It was going to grow besides the demonstration factory of the project, creating employment for about 50 people along with a new market for the women who were selling this product.

After discussing an example of giving people access to new markets for the agroforestry products, Prof. Helen wanted to give some thoughts on the policy impacts and also what that works for attracting investors. She referred to the green rush (to zero carbon) and for sustainable production. There are companies that are

Interventions:

- ◆ Set up a factory and test the market- in Papua New Guinea
- ◆ Product launch in July 2018
- ◆ Work with processors in Vanuatu



Some thoughts on policy impacts and attracting investors

- ◆ For the private sector (smallholders- large organisations) confidence in markets is key
- ◆ For donors
 - ◆ Government policy can give confidence to donors
 - ◆ For example, the Vanuatu sustainable tourism policy promotes locally grown and processed product
- ◆ New investment opportunities: the (other) green rush
 - ◆ The zero carbon economy
 - ◆ Sustainable production
 - ◆ Social and ethical food
 - ◆ Plant based protein



looking for ways to reduce the carbon emissions through agroforestry or forestry. These companies also want to produce food that is sustainable and want to help those potential farmers to produce food that is ethical, zero carbon and sustainable. In her opinion, there is a great opportunity and a real surge of small and large private sector for investment, those who wants to play in this space of agroforestry.

Topic: Agroforestry — A Climate-smart Agriculture Production System

Speaker: Md Abiar Rahman CIFOR-ICRAF

Dr Rahman enumerated the challenges that were being faced especially by the South Asia and many other countries like rise in population, land degradation, yield gaps, input and resources, climate change, weak public private partnership, technology sharing, capacity building, labour and energy shortages, weak value chain, and policies. Climate change impacts in agriculture are now visible those were happening earlier also but now it is being recognized and addressed in the recent years *e.g.*, the rising temperatures and the varying rainfall pattern. If the data pertaining to total rainfall distribution of the last 30 years were analysed, it is clearly indicated that not only in many regions of Bangladesh but also even in South Asia, the total rainfall is increasing but the distribution has been changed, which is a big challenge for the agriculture production and farmers have to cope with these changes of the climate and distribution of rainfall. Some other very location specific problems like flooding, drought, sea level rise, salination, cyclone, storm, *etc.* are simply compounding the challenges. This climate uncertainty and variability has made it very difficult for the farmers. He shared some pictures of the area in Bangladesh to show the effects of climate change *e.g.*, droughts, cyclone, water logging, salinity, diseases and insect pests.

It is very much clear that emission of greenhouse gases has been responsible for global climate change and global warming. Agriculture contributing 13% and land use change 11% that means that 25% was coming from only the agricultural land use whereas various other sectors emitting these greenhouse gases are electricity, energy, industry, transport, *etc.*

There is a need to reduce temperature by 2°C by 2050. It is estimated that by 2050, agriculture and land use change could represent 70% of global emissions. If global emissions has to be reduced in accordance with a goal of 2°C, the agriculture will have to reduce its emission intensity by 60%, if it is to maintain its footprint in parallel with overall emissions reductions. This assumes that emissions from land use change will have to fall to zero.

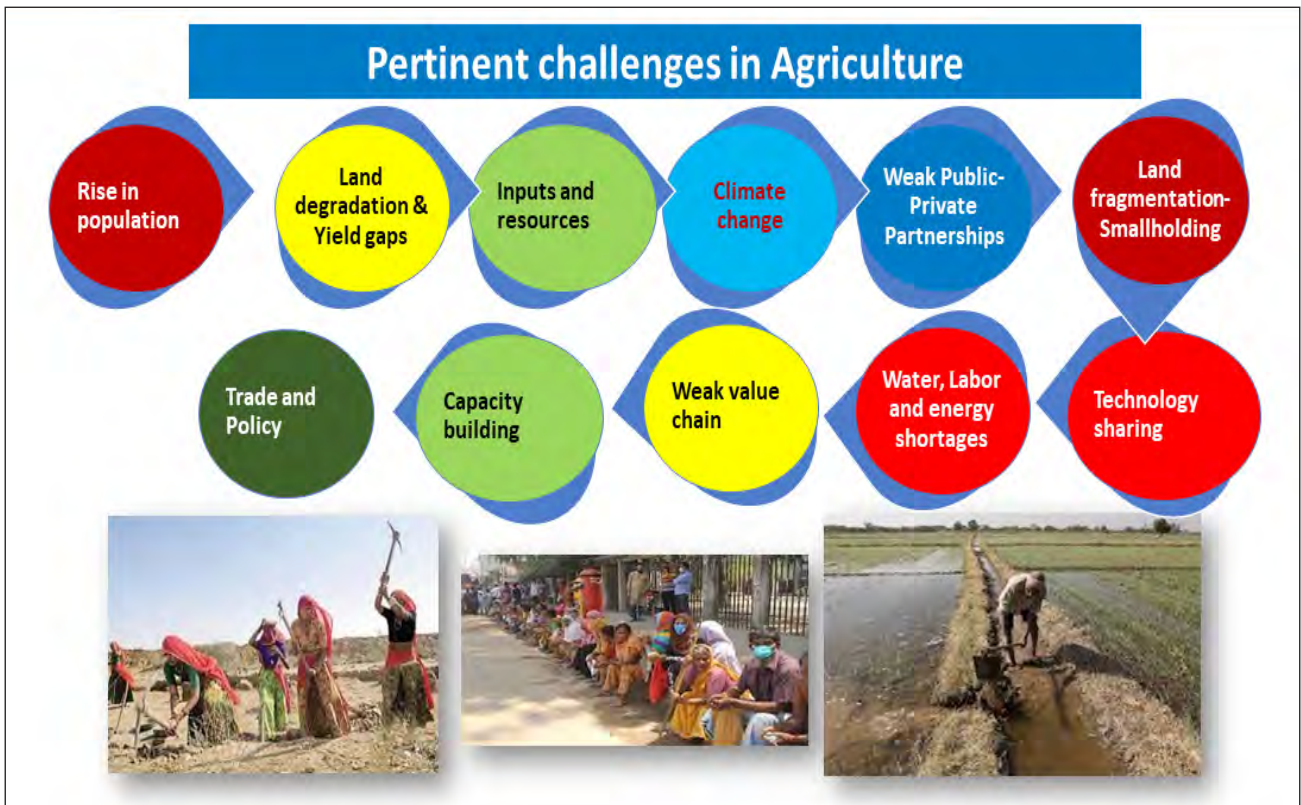
Need of the hour is to build the climate resilience by mitigation and adaptation measures *i.e.*, actions to reduce emissions that cause climate change and adaptations to manage the risk of climate change impacts. The Climate Smart Agriculture (CSA) is now considered as one of the sustainable production systems as well as the resilience system, however, development of this system itself is a very huge challenge. It can be done only if the farmers are recognized — the bottom line farmers, marginal farmers, all the farming communities and food businesses. The CSA has 3 pillars *i.e.*, food security, adaption and mitigation. CSA sustainably increases productivity, reduces climate change vulnerability, reduces emissions that cause climate change (mitigation), protect the environment against degradation, also enhances food security and improves livelihood of a given society.



Md Abiar Rahman

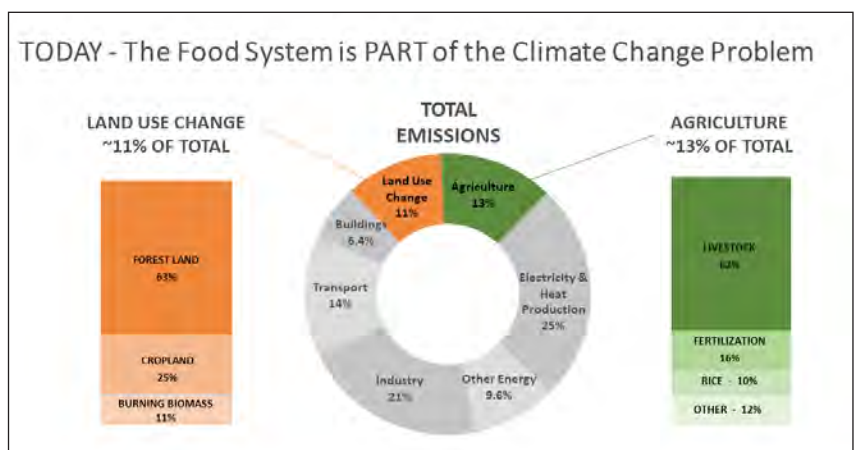
Md Abiar Rahman
Country Liaison Scientist
CIFOR-ICRAF, Bangladesh

Md Abiar Rahman is also a Professor of Agroforestry and Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. He has about 20 years experiences in teaching and research in the field of agroforestry, climate change and sustainable agriculture. He has supervised 22 post-graduate students and published 54 articles in different journals. He implemented several projects on agroforestry and climate change funded by different organizations. His main focus is on tree-crop interactions. He is working to develop a fruit tree-based agroforestry and homestead production models. He has interest on ecosystem functions and services in agroforestry in relation to climate change.



It is well known that the world population will increase by at least one third by 2050 — from 7.3 billion (2015) to 9.7 billion (2050) and to feed them, the agricultural production will have to be increased by at least 60%. But the climate change is a great threat to food and nutrition security making the system vulnerable. In order to diversify food sources and strengthen the resilience of farmers’ livelihoods, there is a need to introduce the integrated approaches. Better agricultural designs and practices like CSA, conservation agriculture, ecological agriculture, no-tillage farming practices and agroforestry systems help in developing resilient agriculture as well as mitigating the climate changes. These approaches are helpful to enhance the vegetation and cropping diversity, improve landscape matrix through better structure and functions and also improve the soil structure and functions. Agroforestry is basically a carbon-smart and nutrient-smart production system. Under agroforestry, the productivity is being increased in agriculture landscape due to intensive cultivation and also soil fertility is increased. The water-smart means it filters the water in the agriculture landscape and it is also a pest-smart as it reduces the incidence of insect and pests in the landscape too. This is also weather-smart, as it improves the micro-climatic conditions of a farm land, and knowledge-smart because a lot of crops and tree components are growing together with the use of knowledge of the species in a single landscape which makes it a very smart system.

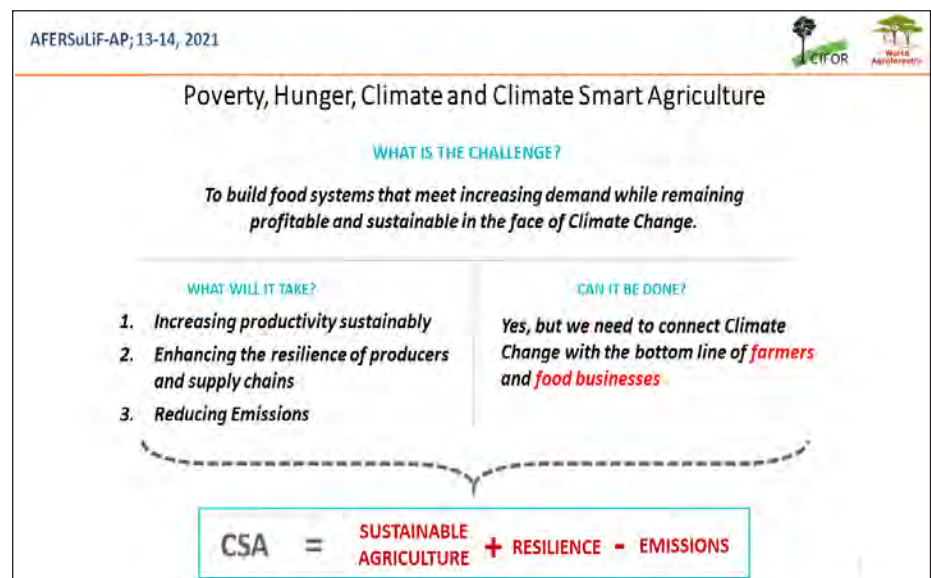
The measures of climate change — adaptation and mitigation through agroforestry were presented. Most important for the mitigations are reducing the methane (CH₄) and nitrous oxide (N₂O) emissions e.g., rice-based system and fertilizer application which are very important for the production of greenhouse gases and N₂O emissions. Agroforestry systems



have the potential to reduce the greenhouse gasses emission. As far as the adaption is concerned, agroforestry eliminates the negative effects of climate change or take advantage of the positive effects, create diversified production opportunities to reduce risk under aberrant weather conditions.

Agroforestry provides a promising climate change solution because agroforestry systems provide and diversify the structure, productivity and help in atmospheric carbon fixation in the vegetation parts and result in close and efficient nutrient cycling along with enhancement in soil organic carbon pools to mitigate climate change. This is also a system of production of goods and services especially from the trees, in the sustainable ways along with carbon offset credits by the agroforestry systems.

Agroforestry mitigates the climate change through land management by avoiding or reducing emissions and carbon dioxide (CO₂) sequestration. Agroforestry adapts the climate change through land management, by enhancing soil resilience and adopting efficient land-use practices *i.e.*, making agricultural landscape more productive. Some examples reported in the literature were cited where by converting



agriculture to agroforestry, the rates of carbon sequestration were increased, while CH₄ and N₂O emissions rates were reduced. Another example was shared from literature where adoption of agroforestry practices for more than 10 years had significantly improved the quality of soil in the area earlier under rubber monoculture and particularly increased soil aggregation, enhanced soil carbon and nitrogen accumulation and improved soil organic carbon and nitrogen distribution within the aggregates. He also presented some examples of traditional agroforestry systems of Bangladesh with trees of *Acacia nilotica*, *Phoenix sylvestris*, *Barasus* and *Artocarpus heterophylla*. Farmers allow these trees to grow naturally which were not planted at specific spacing. Farmers were obtaining a number of products like timber, fodder, products like date-palm and for juice, mollusc, *etc.*, which were of high nutritive value and fetching a high market price not only in their own country but also in many other countries.

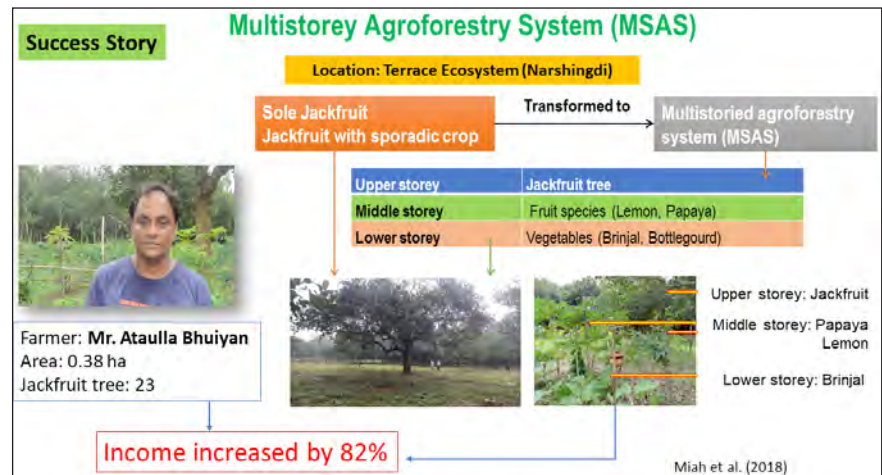
Homestead agroforestry is a very smart agriculture system as was shown pictorially by Dr Rehman because by default, it is practised in a well-protected area and even the landless agriculture farmers had the homesteads. The livelihood activities are concentrated in and around these homesteads. The farmer uses it with different species for different purposes and at different locations of backyard farming. They also have livestock and fisheries components in combinations. The well-designed homestead provides a good livelihood to the farmer of that place or region.

After 1980, farmers were motivated for planting of trees in the agriculture lands, in a very systematic way and in a scientific manner. Presently, a lot of agriculture landscapes were being transformed to orchards of mango, jujube, lemon and guava, *etc.* and plantation of eucalyptus, neem, mahogani, date palm trees was being done by farmers to harness a wide type and range of benefits.

He further presented the trees in rice-based farming system not only in Bangladesh but also in other Southeast Asian countries which are having a good number of rice-based systems. In Bangladesh, more than

70% land was under this system of cultivation. Trees were being planted on the border and many fruit trees have now grown on the risers of the rice fields. Even in the rice fields, when the trees were planted, which were raised and earthen up with the soil. This was a very good example of agroforestry adoption at the farm level for their high income and meeting their land requirements. Another good example was also presented where introduction of trees in rice fields could be used as perching. The local Department of Agriculture claimed that there are some twigs of a tree where birds come and eat the harmful insects. The department further claimed that 10% infestation can be reduced by using this technique of perching system.

A multi-storey agroforestry system was also presented as a success story of a project funded by World Bank and Bangladesh Agriculture Research Council that was implemented by the Department of Agroforestry and Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. A jackfruit orchard which was not managed by farmer properly, later it was transformed



to a multi-storey agroforestry system *i.e.*, top storey of jackfruit, middle storey of papaya and lemon and in the lower storey brinjal was planted. Brinjal was a high-value crop in Bangladesh. This was done at the farmer's fields of Mr Ataulla Bhuiyan and his income increased by 182% after 3 years of this project activity. Interestingly, a huge bearing of jackfruit could be seen in his field. The farmers were not managing the fruits properly and water, fertilizers, and composts were provided for agriculture through the project. The productivity of the jackfruits increased up to 32% and so did the income of the farmer. Not only this, the complete orchard became very green and the produce was available throughout the year. Another fruit tree-based agroforestry model under on-farm conditions was also developed under the research programme. Based on the need and canopy structure, the shade tolerant crops *e.g.*, turmeric and ginger were being cultivated in between the trees. Trees were being planted in a very systematic manner in this system by making a 1 m raised bed in which ginger and turmeric were planted and in between the tree rows, on the open space the high value crops were planted. Papaya dwarf plants were also introduced in the system. Now this system was being introduced to other areas for replication by the farmers.

Other good initiatives were also taken by CIFOR-ICRAF in Bangladesh *i.e.*, gene bank management for jackfruit and moringa. Dr Rahman concluded his presentation by sharing the information that efforts were in progress to develop an agroforestry policy for Bangladesh under the leadership of Dr Rizvi. Good agroforestry practices in neighbouring country of India were also being adopted for the up-scaling of agroforestry.

Concluding Remarks of the Session

Dr Bhaskar, in his concluding remarks, sincerely thanked APAARI and CIFOR-ICRAF for giving him the opportunity to chair this session on enabling policies and scaling-up investments in agroforestry. Dr Javed Rizvi who made a very detailed presentation on various farmer friendly policies being put out by Indian government. He emphatically highlighted those restrictions on felling and transportation of many of the forest species have been removed along with formation of a new submission programme on agroforestry which was launched along with the National Agroforestry Policy. There were many programmes started for

the benefit of the farming community but at times, there was little convergence between the development departments and other stakeholders. Prof. Helen brought out very good success stories with respect to galip nut, involving many of the women folks. She also raised very important points or constraints in the adoption of agroforestry like land ownership, *etc.* He called upon Dr Javed to bring a policy for the entire region instead of regional policies for promoting agroforestry and APAARI being the main organization in this Asia-Pacific Region, it can take up such initiatives in the future. Chairperson concluded with the comments that of course, most of the governments in Asia-Pacific region were promoting agroforestry as one of the components of the farming systems but in his view, agroforestry alone cannot be promoted as pointed out by other speakers also. It is a tree-crop-livestock combination and need is to go along with the prevalent farming systems which are being practiced by the farmers.

Proceedings of the Second Day of the Virtual Regional Expert Consultation

Day 2: October 14, 2021

Session 3: Agroforestry and Entrepreneurship: Lessons from Success Stories

Session Chair: Dr Feliciano Calora Jr., PCAARRD, Philippines

Rapporteurs: Aqeel H. Rizvi, CIFOR-ICRAF and Swati Renduchintala, CIFOR-ICRAF

Dr Tyagi welcomed the participants and briefed about the Session 3. He gave brief introduction of the Chair and the speakers of the session and handed over to the Chair to conduct the proceedings of this session.

Topic: Mapping Spatially Explicit Roadmap for Scaling Agroforestry

Speaker: Chandrashekhar Biradar, ICARDA, Egypt

Dr Biradar presented his talk while explaining what was the spatially-explicit road map for scaling agroforestry and how to bring the new avenues to the scaling agroforestry in the dimension of ecologically sustainable, and viable agro-ecosystems. We were living in the world of broken food system and unsustainable cost to the natural resources. With new innovations coming up and flow of technological information, it is clearly recommended that there is a need of transformative sustainable system. About 50% of our food is plant-based *i.e.*, mostly fruits and vegetables, rest half is coming from the other sources. The way we produce food, consume and dispose has a huge impact on entire system. Climate change action points towards the healthy connection between these natural farming systems and ecologically focused farming systems. It is not only the health of the people is important but also that of planet and ecosystem services. The COVID pandemic had really taught us a good lesson and the diet has become very essential and especially the diet diversity, for building the immunity, coming from the diverse agro-systems.



Chandrashekhar Biradar

In the World Food System Science, mainly focus is on increasing the yield rather than the nutrition. For the last 30-40 years, ecology and nutrition had been neglected in the Food System Science. The basics of bringing back the broken food systems, and returning to the productivity range in the practices, ecology and ecosystem services are major considerations. Ecosystem services are often discussed about but not from structure and function point of view. Generally, focus is mainly on the production and services. But in order to bring the functional production systems, structural aspect is to be looked into first then the functions. However, when functions follow the production, the services are well-begun by default. This really is a key and basis of restoring resilience and farming in harmony with nature and sinking ecology and economy because neither ecology nor economy can be built-up singularly.

A lot of work had been done for crop breeding and tree breeding. It was required to be brought to the sustainable framework and different dimensions like producers, consumers, institutions, science and technology need to be connected through the innovations in ICT, technology and space science.

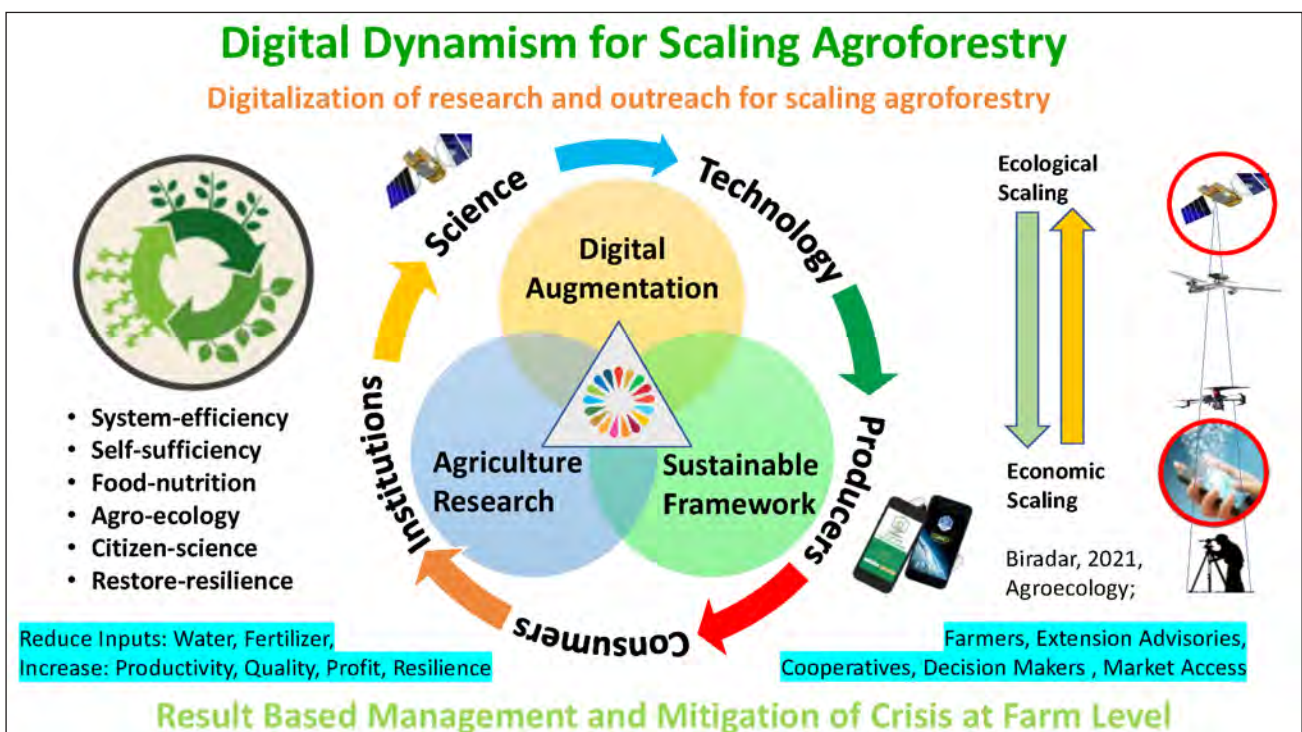
The institutions were going to play a vital role and the factors which bring the system efficiency, self-sufficiency, food and nutrition, ecology and citizen science need to be enabled for resilience. Dr Biradar considered satellite and the space as a kind of the viable tools to the scaling domain. Nearly 80% of the Big Data flow was coming from the space and the ground. Need of the hour is to interconnect, to make a system workable and for result-based management.

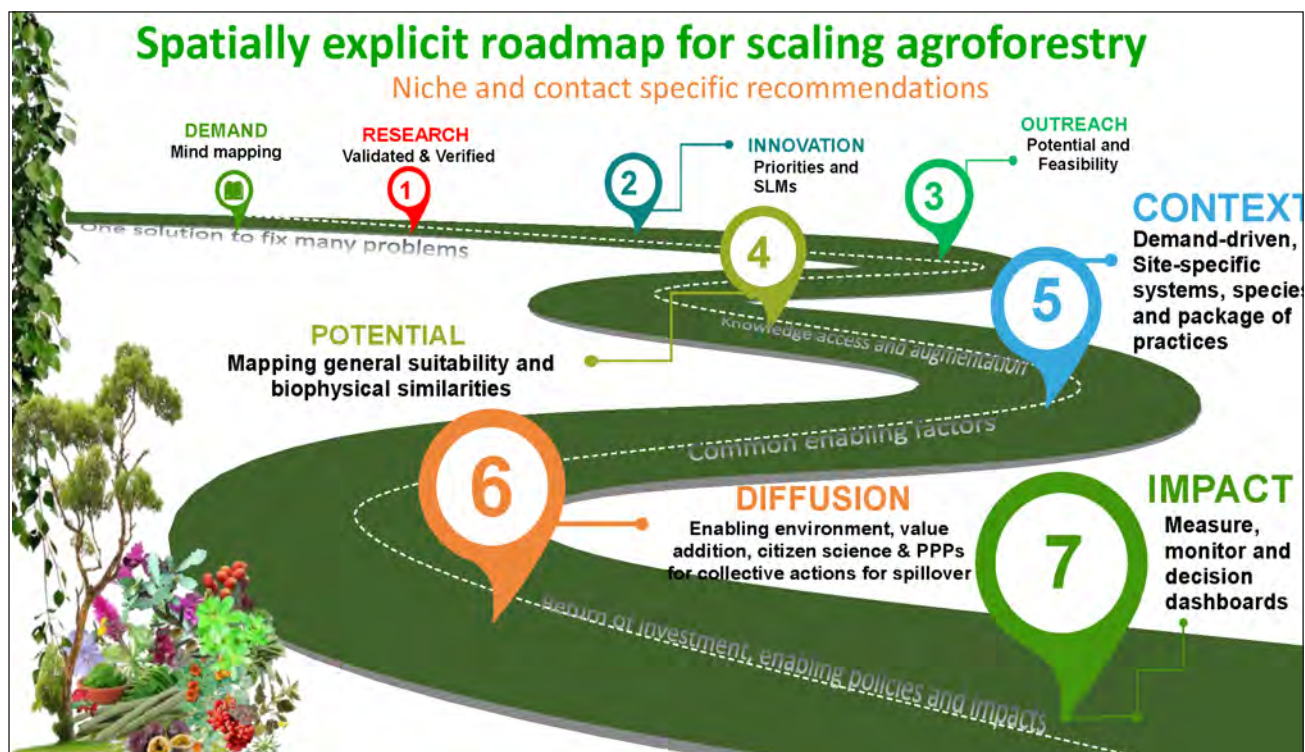
Dr Biradar mentioned that about 144 satellites around the world are there and about 10 out of them were covering wall-to-wall coverage. Out of that, 5 satellites were available freely at different scales and recently Norway is investing about 450 million USD to make a 5-minute Planet Lab that will be available to the entire research community across the world. There are Sentinel and Landsat and other satellites also. This really had opened up a new dimension to look into the landscape prospective from the space and to make a decision on the ground level. Nearly 50% of the world population has now access to the smart phone. The open access data, cloud computing and ICT enable citizens which opens the tremendous opportunities to realize the maximum potential and use of data.

The question is how to connect the production, consumption, conservation and restoration which significantly affects the people, culture and nature. IPCC clearly mentioned that the broken food system cannot be fixed

Chandrashekhar Biradar
 Research Team Leader
 GeoAgro for Sustainable
 Agroecosystems, ICARDA, Egypt

Dr Chandrashekhar Biradar is a Research Team Leader & Principal Agroecosystem Scientist at ICARDA-CGIAR Center. He has multi-disciplinary educational backgrounds in Forestry, Environmental Sciences, and Space Applications with expertise in agroecology driven food-system transformation. He has authored/co-authored over 225 publications. He received several international awards, viz (notable) Best Team-Initiative 2005, Young-Scientist 2006, Outstanding-Scientist 2013, Excellence in Agriculture Extension 2021. His research interests are — harnessing technological innovations & citizen science for restoring functional agroecosystems for ecologically sustainable and economically viable solutions for delivering SDGs and rural welfare. He also designed and demonstrated biodiversity gardening, food-forest models and multi-layer farming for mainstream agriculture.





without being back to the nature with solutions to address the root causes rather than the symptoms alone. It is the time to fix the consequences of the no actions made during the last 30-40 years. It is also time to realize how agro-ecosystems can really play the vital role and address the issue of bringing back the broken system. Most of the agroforestry systems are more focused on the wood, timber and industrial inputs. There has been a shift — completely moving towards a food-based, commodity-based and to the product-based systems. There is a need to work out how best the existing technology can be leveraged and make a big impact as there was a huge demand for bringing the changes into the mainstream farming systems. Enough research has been done in agroforestry, but what is required is scaling-up of those different technologies. Research has been done on the best fitting crop and tree into the agroforestry system, innovations in terms of the planting and post-care technologies, etc. In this context is specific options, demand-driven, site-specific systems, site-specific species and package of practices which actually vertically augmenting the knowledge together are required. This is basically the diffusion of the technologies that comes with scaling, enabling, environment, value chain in science and public-private partnership and connects the actions for the spill over impact. Undoubtedly, these have resulted in return of the investment and changes in the policies but people were not aware of even what was happening in areas of the agroforestry policy. Though, agroforestry policy had been launched in several countries, yet individual farmer is not aware of the same.

Enough work has been done on the mapping of the suitable agroforestry across the world. The world has nearly over 5.1 billion ha agriculture area and out of that 80% is still agriculture that means basically unsustainable practice of agriculture. Nearly 1 billion ha are under agroforestry having 10% tree cover. It means that out of the 5 billion, nearly 4 billion ha agriculture areas require the trees in the farming systems. In Southeast Asia, 57% of land pertains to the agriculture and mostly 82-90% of the areas were without any tree cover. There is no potential tree cover which need to make it sustainable; and nearly 70 million ha area that supports 1.9 billion people *i.e.*, nearly 1/4 of the world population. The biggest challenge in the cradle of agroforestry in Southeast Asia is to scale-up the agroforestry for about 71 million smallholder farmers.

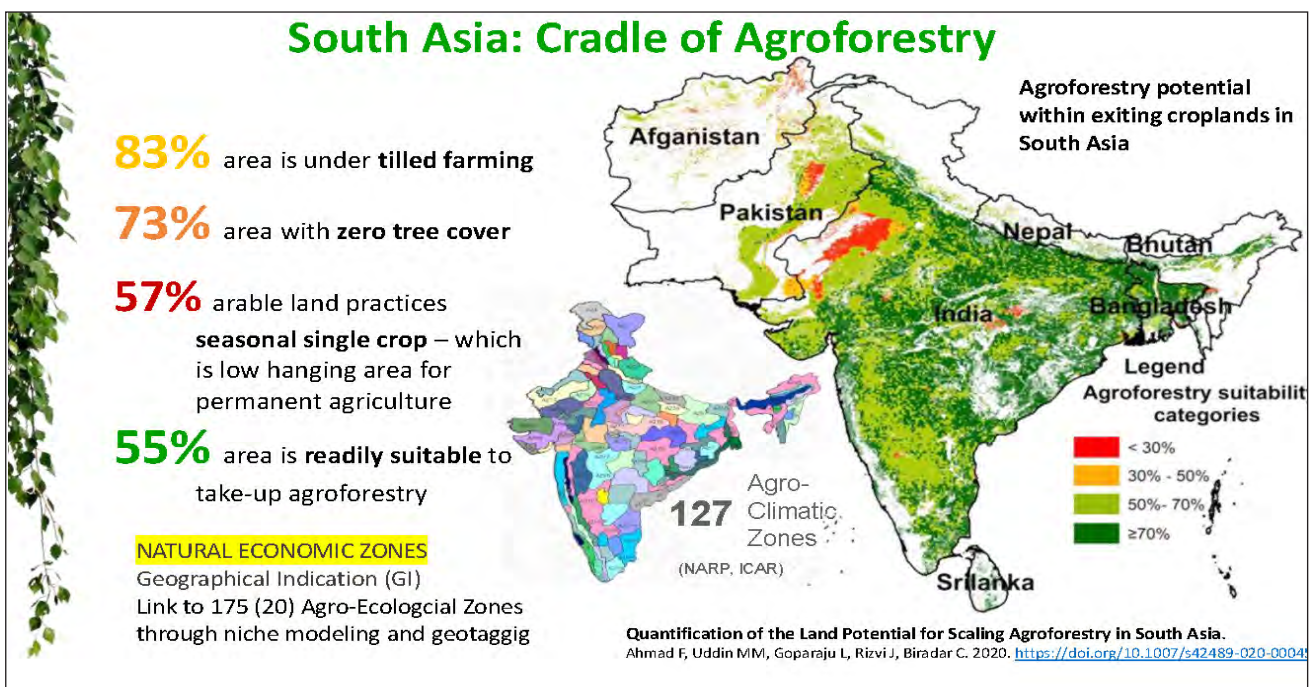
In South Asia, nearly 83% of the area is under till farming and 73% under zero tree cover, *i.e.*, there is a huge potential to bring it under agroforestry. Out of that area, 57% was arable land but with single seasonal

agricultural practice, about 50% of the area can readily be taken up for agroforestry. In India, there are nearly 127 agro-climatic zones, each with a separate geographic indicator and becomes a priority for poor, consumers and at policy level. We have to develop a system to identify the species which can be readily available for bringing under the farming practices in those vertical and natural economic zones, basically called as site-specific and ecologically intense application.

While working with NASA, mapping of the monsoon forest in Asia and industry plantations was done by his team and a quick exercise was done to work out the potential area in terms of the trees suitable for farming system. Satellites provided data almost every day and at higher resolution. This opened up really a tremendous area to identify the remnants of those existing farming systems and how such systems could be further scaled-up. We could identify the areas which had persistent green cover and also the land where there was no tree cover for at least about the majority of the year. Whenever there was a rainfall deficit year then even in drought-prone area, some of the green patches with trees were recorded *via* satellite. Those were the farmers' sustainable viable systems and despite of the drought, these agroforestry systems were still producing very well. Thus, in order to scale-up agroforestry, there is a need to follow the top-down approach and look for those potential zones *i.e.*, physical similarity mapping. Looking at the economic scale at the ground level, geo-tagging of those systems which provide a matching factor for the scaling really opened up a new dimension to bring the scaling factor at both ecological and economical level.

To quote an example, the travel stretch from Bangalore to Delhi (in India) was mentioned where through the entire stretch of this landscape, no tree cover was found in the farmers' farming systems. In India, it is nearly 60% of the rain-fed agriculture system and that area is without trees. It needs a paradigm shift moving from the seasonal agriculture to the current agriculture and these are the low hanging areas for mainstreaming the agroforestry. Another important dimension to be added is to see the efficiency of the crops grown and perennial fruits in terms of the nutritional value resilience. Sustainability is completely neglected in the food system science and also there is a need to bring the carbon neutral cultivation where agroforestry plays a vital role.

During trial mapping exercise, it was found that it offers a huge potential to bring this mainstream farming almost everywhere in order to move away from the green revolution systems, where about 80% of the trees had been completely removed from the lands. Some drone mapping and high-resolution satellite imaging

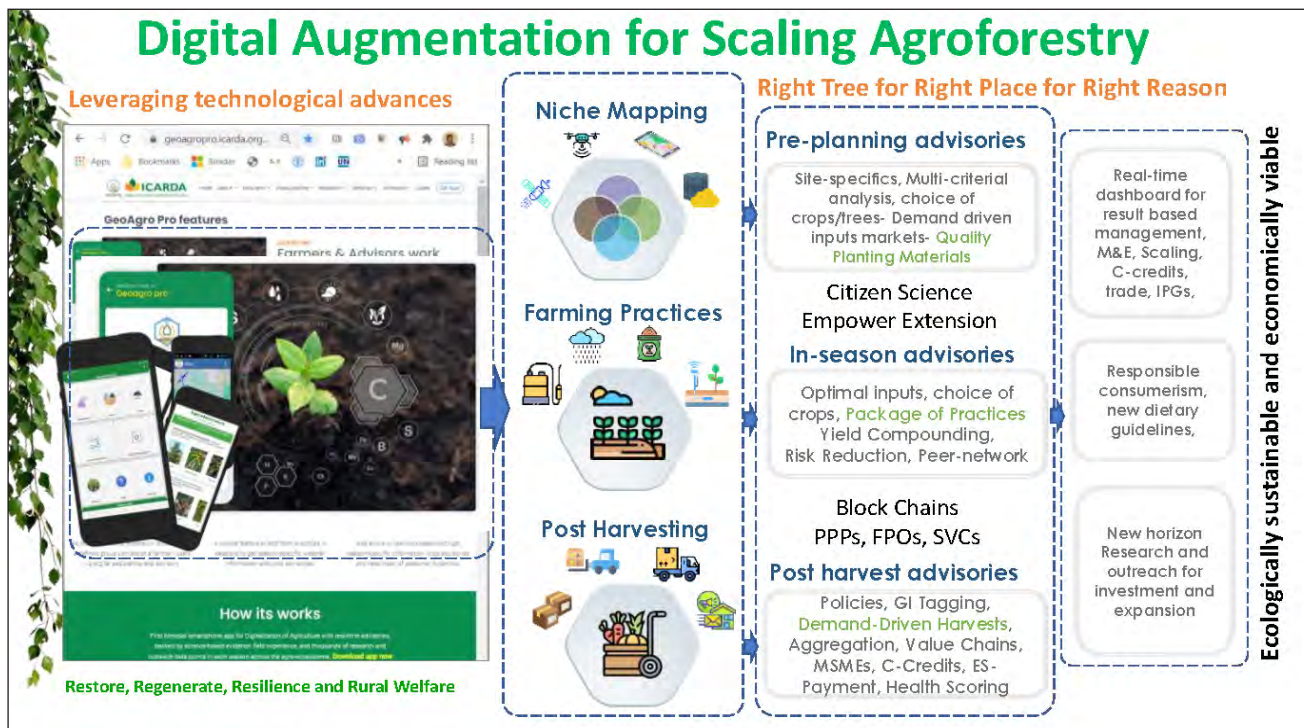




was done in Odisha and West Bengal. There is a huge potential not only in terms of the wood or timber for industrial inputs but also for wellness during the COVID period as there had been nearly 23% increase in the demand of the native fruits.

Another example mentioned was the high-resolution satellite image showing an agriculture area but with much of the variability in the farm. Some farmers burn the residues, some have farms with higher moisture along with the trees and some have followed different management practices. With so much of the diversity at the farming system level, it is required to have fingerprinting of farming systems specially for farm decisions for the site-specific recommendations and market excesses. For example, in Dewas district of Madhya Pradesh in India, cadastral maps were developed to map the length of the farm boundaries to determine the tree cover to reach the government recommendations of the ambitious plan to have 33% forest cover area. There is a need to sequester about 3 trillion ton carbon emissions to meet the SDGs. However, a huge potential available to grow the trees only along the farming bunds instead within the farms. This was the 700,000 ha arable area of the district. Figure given in the slide indicated that the length of the farm boundaries estimated from those terrestrial boundaries contributed nearly 295,000 kilometres and plantation can be done in just about 2 metre on both sides of the bund that is about the 4 metric canopy cover. This way it can increase trees outside the forest to nearly 18 to 19% with just increasing the canopy cover of one metre. Trees around the farm will not only just contribute towards carbon sequestration, but will also provide multiple benefits.

Dr Biradar discussed another example of Indian roads. As mentioned by Dr Rizvi also that 5.8 million kilometres length of Indian roads are available and out of that as per the satellite data, only <10% is planted with trees. This opens up the different dimensions required for mapping the gaps and identifying low hanging fruit trees for systematic plantation wherever possible. Where the vegetation had been constant in the past but now the significant increase in areas under trees is realized. There had been a tremendous technology advancement in the recent years and especially in terms of the high resolution supply data, cloud computing and machine learning so as to help in identifying different farming systems and then how best they can be linked with CSR and carbon credits to prioritize maximum return of the investment. He also mentioned about the mobile applications. More than 500 mobile applications are available for farming. A lot of work has been done in ICRAF, ICARDA and in number of private sectors for developing the working



technologies. What is required to document is the right tree at the right place, niche mapping, farming practices, food harvesting and especially the availability of quality planting material for the farmers which should be able to link to the nurseries. There is a dire need of the extension systems, in season advisories, especially in terms of package of practices and making use of the technology served to the plant chain uses — the demand-driven harvest, how farmer can produce, can take a picture on the phone and send to the buyers, *etc.* We need to look into the real time dashboard to identify and fill the gaps in responsible consumerism so that economically viable and technological sustainable options are made available.

It is important to show to the farmers and to the people about what was happening on the ground (*e.g.* in terms of carbon sequestration, phosphorus and vegetation, *etc.*) through technology. They should be explained about the importance and comparison of agro-ecological approaches with the conventional approaches and how the vitality of the system was very important for the scaling-up and bridging the gaps with the agro-ecological transition. There are a number of cases depending upon the gestation period of the agroforestry in which there is return of the investment within the same period. This is a win-win situation for the farmers, consumers and the nature. The most common thing asked by the farmers is about the availability of the quality planting material. How and when to plant in companion, managing irrigation for first 3 years, knowledge on the value additions, market access, aggregations, how to use the digital tools are some of the common questions asked, where we need to bring these dimensions for changing landscape. Another one dimension is that in order to make a sustainable development proposal, we have to cover the soil, cover the land park with the trees in the farming systems. That really helps us to address what is called the simple formula to farmers as “the day the clean water flows from your land as subsurface flow rather than the surface flow that is the day you reach the sustainable development”. This is the future of the healthcare system, looking into the nature care, soil care, people care and bring the trees in farming system. He concluded his talk with a comment that the production follows function and let us leverage the technology, ecology, diversity, local indigenous best practices, farming system dynamics to reach to the broken food systems. In his own words “The trees are the source of the sustainability everyone well knows, but we have to bring that into the individual farmer level, consumer level and it is not too late to say that we have the next decade of agroforestry system.”

Topic: Agroforestry: Food and Nutritional Security

Speaker: **Stepha McMullin, CIFOR-ICRAF**

Currently, the world is affected by the triple burden of nutrition. The first dimension of the triple burden is undernourishment related to hunger, lack of food and lack of energy intake. In the map (as shown below), there are many low- and middle-income countries having varying levels of undernourishment. The statistical data from some of the countries in Asia-Pacific region revealed that in India, the rate of undernourishment is 14%, in Thailand 9% and in Philippines 15%. The second dimension of triple burden is over nutrition, overweighs and a look at the map reveals that no place in the world that is really getting away from overweight and obesity, with levels increasing even in low- and middle-income countries. Two billion adult are affected by overweight in the world and in Asia-Pacific — obesity in India is 19%, 35% in Thailand and 26% in Philippines. The third dimension of the triple burden of malnutrition is lack of essential micronutrients like iron, zinc, Vitamin A, etc. Billion people globally are affected by micronutrient deficiencies often referred to as hidden hunger in the world which also coexist with undernourishment and over nourishment. Citing examples, Dr McMullin informed that a very high rate of Vitamin A deficiency is reported in children under 5 from India (62%), Thailand (16%) and Philippines (40%). Thus, this huge burden of malnutrition is varying to different levels across different regions of the world. Subsequent and new dimension of this burden of malnutrition is the emergence of non-communicable diseases. These are common diseases, such as cardiovascular diseases, respiratory diseases and diabetes, etc.



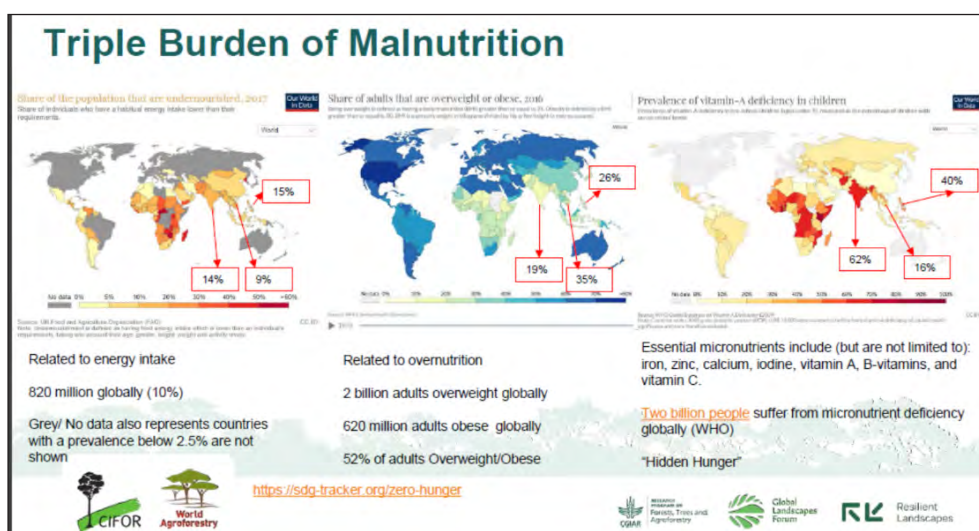
Stepha McMullin

Stepha McMullin
 Development Specialist
 CIFOR-ICRAF, Kenya

Stepha holds an MSc in Development Studies and a PhD in Rural Development from the School of Agriculture and Food Science, University College Dublin, Ireland. She is currently working on projects that have a strong nutritional component, specifically focusing on assessing the role of biodiversity, trees and agroforestry systems and their contribution to positive nutritional outcomes, livelihood diversification and community development.

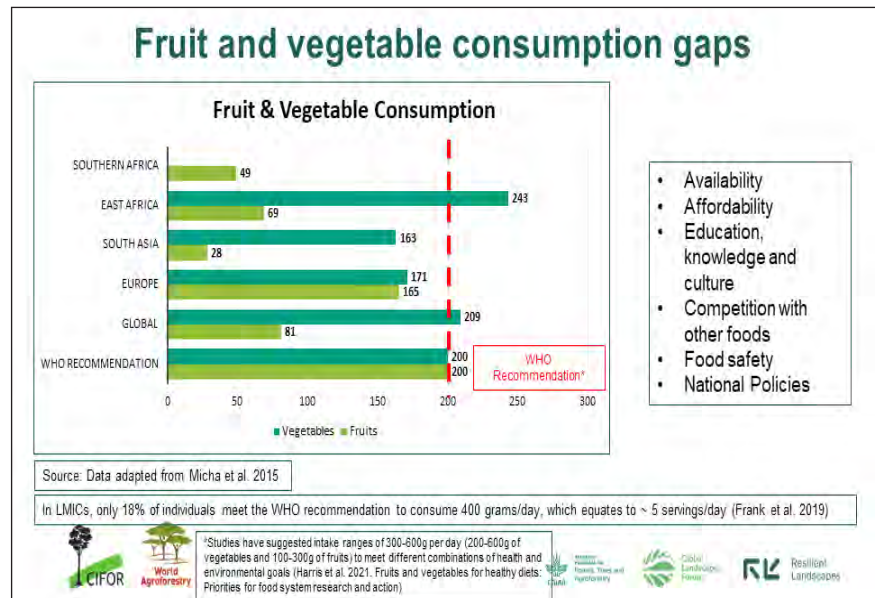
There are multiple reasons for this emergence of non-communicable diseases but one of them is dietary risk factor. This relates to increased morbidity and mortality which is often caused by the low consumption of nutrient-dense foods such as fruits and vegetables, and the overconsumption of foods which are high in fat, sugar and are highly processed. The low intake of micronutrient alone has attributed to about 3 million deaths. The evidence shows that diets that are rich in nutritious food such as fruits and vegetables which can overcome the risk of communicable diseases. Considering the triple burden of malnutrition and the subsequent emergence

of non-communicable diseases, there is often one common nominator and it is the diets that are poor in quality i.e., in terms of micronutrient-rich foods, diversity or eating too much of bad food. Indeed, if we look at for vegetable consumption across the world, many prominent gaps are visible in terms



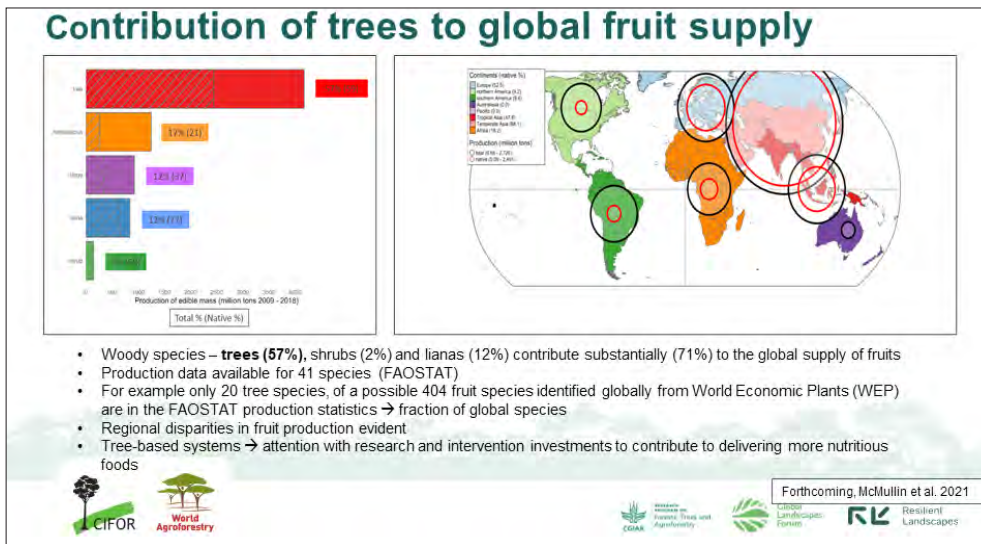
of intake. If we take the WHO recommendation of 400 g of fruits and vegetables per person per day, it was quite evident from the graph as indicated by the red line that many regions in the world are not meeting the minimum dietary requirement. In Asia, for example, on an average there is only 28 g fruits per person per day are consumed. Interestingly, vegetables are consumed more than fruit. There are multiple reasons for low consumption of fruits and vegetables. It relates to the availability of the fruits, education, culture and knowledge for what foods to consume and why they are important. Increasingly, the urbanization and other factors are also seen in competition with each other. Highly processed, convenience foods which people are turning to, have issues of food safety. In many countries, national policies are not promoting the increased consumption of processed foods and also addressing the production issues related to such foods.

There are gaps in the production of fruits and vegetables. According to the WHO dietary recommendation of 400g of fruits and vegetables per person per day, it is obvious that only one region in the world Eastern Asia actually produces enough of fruits and vegetables to meet and exceed the dietary requirement as shown in the diagram. In all other regions of the world, production is actually not keeping up with the dietary recommendations. In southern Asia, the production of fruits and vegetables is not meeting the dietary recommendation and fruits are often consumed in much lower quantity than the vegetables.



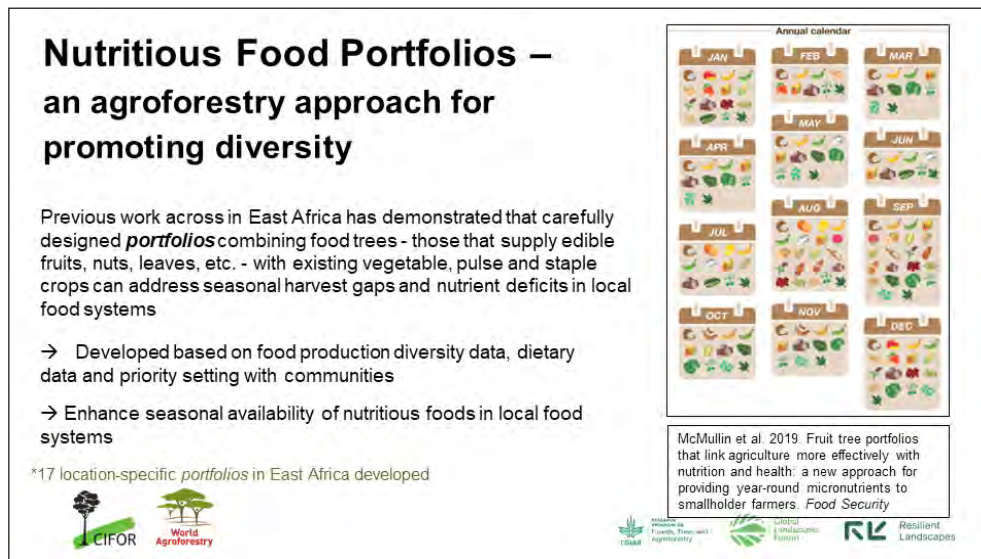
Back to trees playing important role and global fruits supply, the contribution of trees at global level could be quantified at ICRAF while working with some data from FAO. Nearly 60% of the world fruit supply is actually derived from classified fruit trees and the rest is coming from other types of plants. There is substantial contribution of trees to deliver fruit in food system. However, there is still a huge data and knowledge gaps, because there is only 41% production data actually in the database. The map in slide clearly revealed the regional disparities in fruit production which were evident in terms of the volume of production of different fruit species and whether those species were in Asia or excluded to the different regions. So, essentially tree-based system such as agroforestry does play an important role in continuing to deliver the nutritious fruits into global and local market. In addition to nutritious fruits, trees also provide other products such as seeds and oils, complement and diversify staple-based diet depending upon the seasonal nature of trees. This means they can deliver harvest at different parts of the year and often with species in certain locations at being available for harvesting even during tough times of the year. Due to higher tolerance to drought when other foods are not available, trees particularly indigenous or native species are often very well adapted to their location and can really support local food system.

For a long period, there had been a narrow focus on crops from nutrition point of view. It is not only undermining human health and results have explained high levels of burden on malnutrition, but the emerging diseases would also be degrading ecosystems so that they are not able to function well and deliver ecosystem services. Availability of the micronutrient-rich crops such as fruits and vegetables in the local food system are also affected. In terms of local food systems, the need of the hour is to change them towards delivering greater diversity



of food and protecting precious local fruits. It is well known from ICRAF’s research that greater diversity of species can improve the livelihood and resilience of the system. In ICRAF, an approach named ‘Nutritious Food Portfolios’ has been developed which is a local solution and context-specific. These

portfolios were developed to meet different food, nutrition and livelihood needs of local communities. Dr McMullin categorically referred to previous work done in East Africa where these carefully designed portfolios combining fruit trees were demonstrated and it was found that these were providing not only the fruits but also the nuts, leaves, seeds and oils. If we combined certain mixtures of species with existing vegetables and staple crops, we can potentially directly target nutrient deficiencies that exist in those local food system. These portfolios were developed using different types of data on parameters such as food production, diversity, water use by reducing what they potentially produce in terms of species diversity.



Data were also collected pertaining to the dietary conditions of the communities, in terms of what they were eating, so that it could be assessed that what food groups and micronutrients may be missing from their diets. A very important point of this approach of portfolios was that these were developed after discussion with

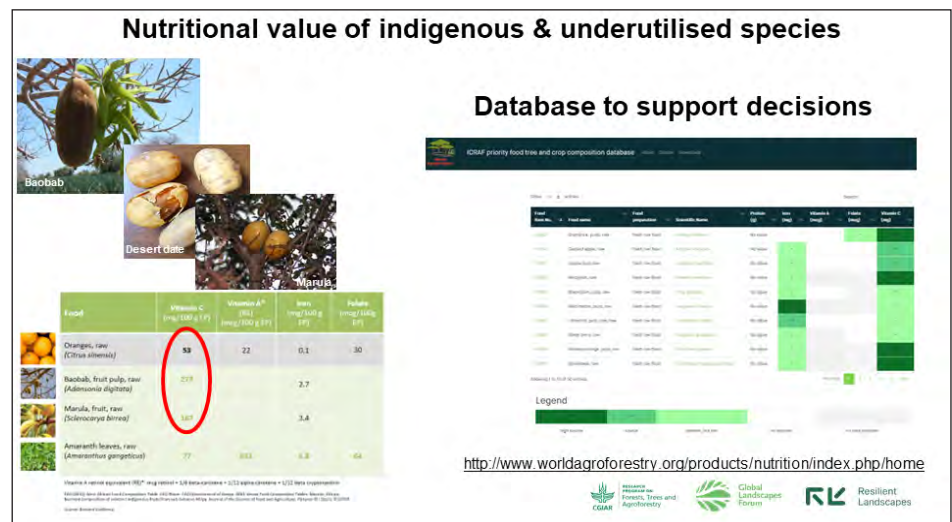
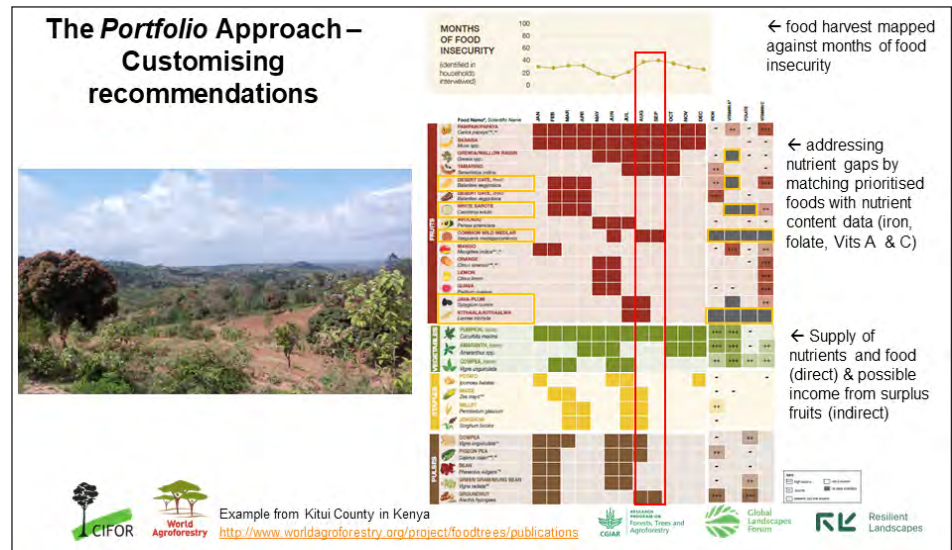
communities regarding their preferences for species, whether they meet food income or other needs, etc. So essentially, these individually customized portfolios should enhance the seasonal availability of nutritious fruits in local food system. Seventeen location-specific portfolios had been developed across East Africa and the methodology in this approach can be taken on to be applied to any country in the world.

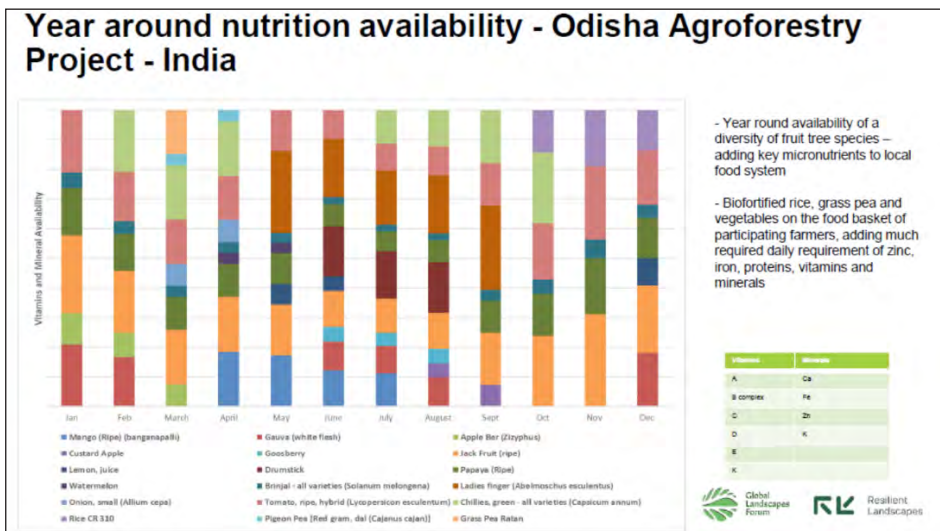
Dr McMullin explained building of one of portfolios with the help of an example from one of the sites in Kenya. They used different types of data, quantitative data to unlock the production diversity in a particular site system. They had some food consumption information also which helped to understand dietary gaps and conversed with community to know their priorities enabling to list priority fruit tree species. Subsequently, it was done for vegetable cycles and pulses because a full dietary approach was followed for promoting diversity in local food system. Each of the species was mapped for its months of availability during the year and also

mapped against the months of food insecurity at the different sites. Importantly, as part of the portfolios, micronutrient data (Vitamin A, B and iron-based priority micronutrients) were also mapped for these sites.

The reason for selection of above micronutrients was because these were of public health interest and also fruits and vegetables are natural suppliers of these micronutrients in the food system. During this work in East-Africa, it was observed that quite often, the micronutrient content information for fruit tree, particularly of indigenous or native species was missing. This showed that there was a huge gap for data and knowledge because there had always been focus on the more common species

whereas indigenous and native species had huge potential in their local system as they were very well adapted and had high nutritional values. But because of lack of information, these species were overlooked. She elaborated with an example from Africa as her work had contributed the maximum in this aspect. Nutritional information of iconic African species of baobab (*Adonsonia digitata*) revealed that it had 3 to 5 times the value of vitamins C than that of oranges which is usually taken as a reference species for having high vitamin C content. This shows that there could be huge potential for the indigenous or native species in terms of the levels of micronutrients that these species may be supplying to the system but quite often such data are missing. So, to partially fill this gap, ICRAF developed a fruit crop composition database which was available freely to access on their website. In this database, standardised food composition and micronutrient information (iron, foliate and Vitamin C) for different species that came up within their research had been compiled. A scoring system was also developed to simplify this nutrient content information. This database is fully functional as a decision support system, so that users, stakeholders can access and select different species based on higher micronutrients values. Another example quoted was from Odisha agroforestry project in India where ICRAF group had also been working very closely with communities to understand the production diversity in those particular systems and following the similar portfolio approach. They had also been looking at the diversity of different fruit tree species, the months of their availability throughout the year and the different micronutrients that they were supplying into that local system.





As mentioned earlier also, the portfolios are really all about promoting greater diversity of species in the system that address seasonal needs and nutritional needs of the system. It is known that often the tree system component is really a huge bottleneck in success and scaling of agroforestry projects. Through the projects in East Africa, they had taken multiple entry

points working with different parts of the community. They had engaged schools and used innovation hubs to promote the portfolios plant demonstration gardens. In this way, technical information on nutritional aspects passed into the community through school children and youth. They had also established central agroforestry innovation hubs and demonstration garden for training, knowledge sharing and dissemination. In the 3rd entry point, work was carried out closely with community seed and seedling hubs, because quite often these could be anywhere in very rural locations and could be much more accessible to farmers which made further away from more central agroforestry or nursery hubs. Multiple entry points were used to make sure that the recommendations were effectively communicated for diversity in a given system. It was also ensured that the quality planting material along with associated technical information for planting, managing trees and also nutrition messaging are available to communities.

The presentation was summarised with a note that it is a well-known fact that trees provide nutritional food, diversified diet and indirectly to income impact pathways which can also make sure that income is available for purchasing other foods and also provide ecosystem services. There is a need to change local food systems in many parts of the world to move towards delivering a greater diversity of nutritious foods and contextually relevant solutions are really important to local community. The portfolios as an example of an agroforestry approach are all about promoting greater diversity of fruit tree species, season crops on farms to address seasonal resilience and diversify the diet. The importance of indigenous or native species should not be overlooked because these species are adapted to local systems which have huge nutritional value to contribute to the local food system. For any success in production and scaling, it must also be taken care of that farmers have

Entry points for outreach and scaling

School & Youth Innovation Hubs

Agroforestry Innovation Hubs

Community Seed & Seedlings Hubs

- Local initiatives
- Community engagement
- National partners

CIFOR | World Agroforestry | CGIAR | Global Landscapes Forum | Resilient Landscapes

access to quality planting material so that they have success with their trees in 3 to 5 years. Portfolio approach can be replicated anywhere in the world. Methodology is available online and it would definitely encourage people through some projects or through interest to start applying that methodology in different countries.

Topic: Agroforestry and Tree Outside Forest (TOF) Business Incubator

Speaker: K.T. Parthiban, FCRI, TNAU, Mettupalayam, Coimbatore, India

Dr Parthiban addressed the gathering particularly on what happened in the industrial agroforestry and how this was helping the system of creating or maybe enabling establishment of the trees outside forests along with the opportunities of developing consortium and business applications. He discussed the journey of agroforestry to the technology-based agroforestry leverages particularly in the state of Tamil Nadu, India. This had a replication potential not only within India but also outside the country. This model had been implemented as consortium approach, leveraging technology and translating technology not only to enhance it outside forest, but also to create entrepreneurs' start-ups through agroforestry business incubation.



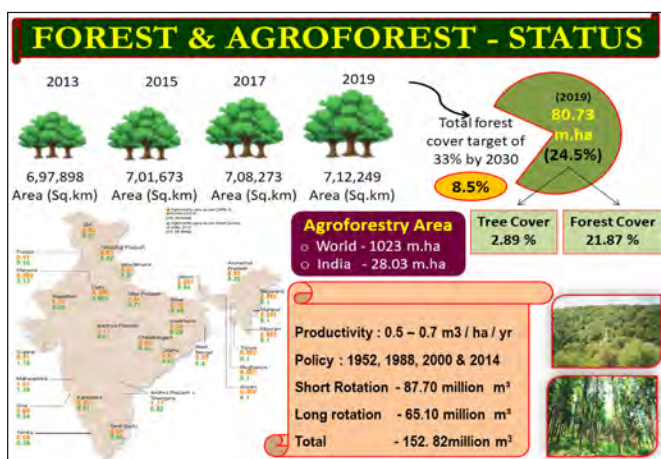
K.T. Parthiban

India is a very unique country in the sense that 95% of the forest in the country is owned by government *i.e.* public sector. Physically no wood is available from the natural forests to the people either for the domestic or the industrial use.

India's forest productivity is one of the lowest as compared at global level. Other important thing is the policy and the legal ways. In early 1880, the government of India implemented Forest Conservation Act that delineated the use of forest for any other purpose. Even then in 1988, government of India enunciated national forest policy that states very clearly that industries established in India, which depend on the wood for the raw material supply, will have to look for their own raw material supply from outside the forests. Also, there were guidelines and directions to the industries, starting from timber industry up to the local paper and plywood industries, to go to the farmers in the form of agroforestry or farm forestry or for any tree outside forest programme. Leveraging technologies for supply of wood support system *i.e.* called as soft wood supply system and marketing system, there has to be a defined supply chain to have the products. Ultimately the directions were very clear that the industries will have to show their raw material resources from the farmland and not from the forests. But even then, several industries, may be except a few industries in South India and may be a few industries in North India, have

K.T. Parthiban
Dean
Forest College and Research
Institute, TNAU
Mettupalayam, India

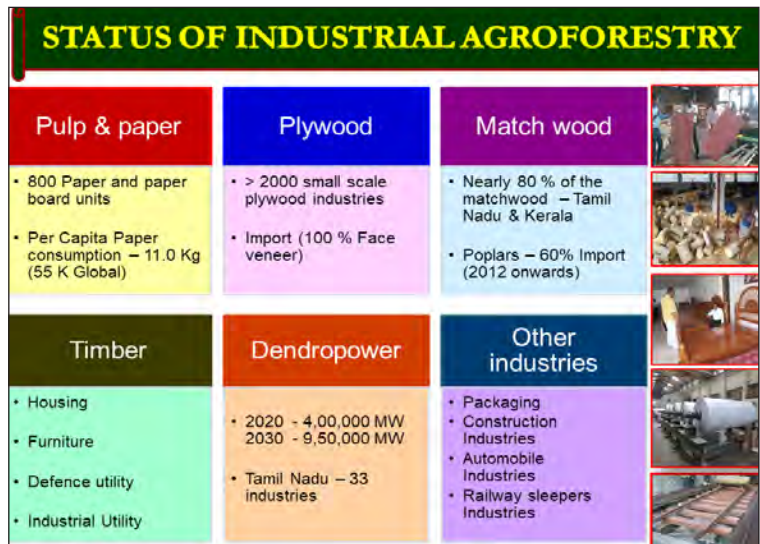
Dr Parthiban has 25 Years of experience in teaching, research, outreach and business developmental activities in professional forestry. While working on tree breeding and biotechnology with specialization in Industrial Agroforestry, he has released 7 clones in trees, developed high yielding short rotation hybrid clones in *Jatropha* for biofuel utility; an innovative and pioneering Miniclonal Technology for tree crops; implemented value chain models for industrial agroforestry; established Consortium of Industrial Agroforestry; established Agroforestry Business Incubator. He is also serving as research and policy expert on several expert committees for business development in agroforestry.



not followed the policy ingredients. Consequently, there was deforestation as wood is available from the natural forests to these industries. Considering this fact in 1990, the Hon'ble Supreme Court of India totally banned the felling in the natural forests. It was a very critical system where all the industries had to look for planning for the establishment of trees outside the forests. When one opts for the trees outside the forests, ultimately that all depends upon what are the trees which have to be taken outside the forests in agricultural land use system.

was 3-5 kg. After 1980s, India has introduced computers at large scale. After introduction of computers, all the people and the policy makers thought that demand of wood will come down, but it became almost double. The reality is that in order to produce 1 kg of paper, 4-5 kg of wood is to be crushed. In the energy sector, though liquid petroleum gas (LPG) cylinders are being provided to all the families, still there is increasing trend in daily energy utilization as well.

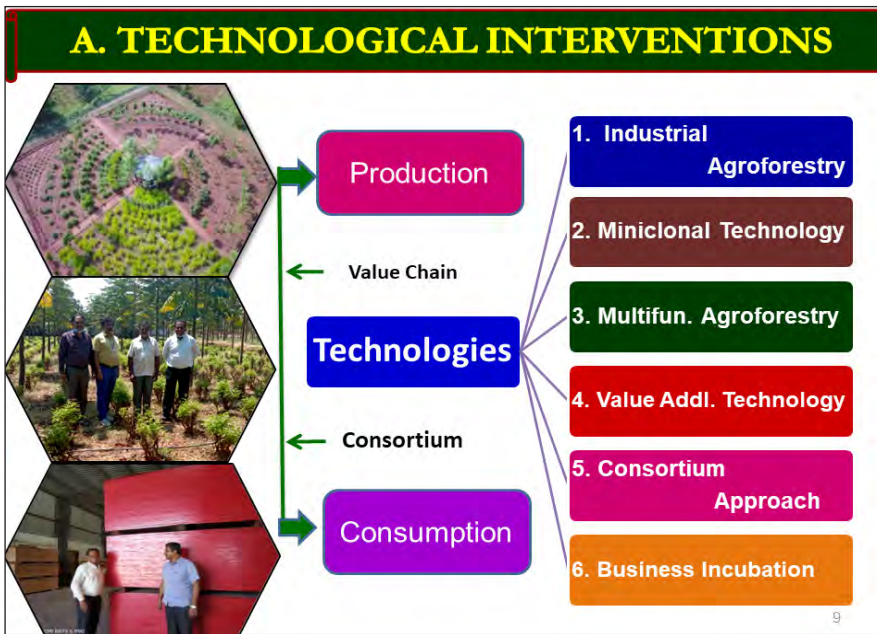
This particular project was started 2004 onwards and prior to that the wastelands



had been identified along with the problems, challenges and constraints. Normally it is said that agroforestry is an age-old practice, and it has started since the art of civilization started. But agroforestry in those regions was treated as a livelihood opportunity. Today agroforestry is translated as a raw material resource for commercial industries, corporate industries, and domestic sector. There is a need for a paradigm shift from traditional livelihood to the commercial and economic form of organized sectors. Three levels of constraints have been identified to enhance productivity and profitability. One is always the production level constraint. Even in the agroforestry systems, the productivity is very low. The non-availability of the quality seedlings even today was a constraint except for few industries, where 100% plantation was done with quality planting material with the improved genetic stocks. There must be an over productivity and also genetic productivity. Farmers are not ready to wait for long rotations for 10 or 20 years or even up to 30 years. The rotation period is to be reduced, by adopting a technical way of harvest rather on the basis of age of tree. There is a need to explore alternate commercial utilization of the agroforestry. Adoption of the silviculture technology, while planting in natural forests, becomes practices when used in farm forestry or agroforestry. In the Forest Research Institute, precision silviculture is adopted *i.e.*, precise information about the site, soil, spacing, density, the adoption of wood, regeneration of wood and food production in the same region. Normally this had been a successful model in Punjab and Haryana and in some parts of Andhra Pradesh. All these models were leveraged in Tamil Nadu also as a new model which was not only taking care of both wood and food production in the same area but had addressed various other issues also. It enhanced the productivity but simultaneously the availability of the raw material also both for domestic and industrial use. The industry started using the wood after de-barking. Today all the industries were looking for the de-barked wood. Farmers

were not able to de-bark themselves. Above all, due to construction related problems, farmers are worried because there were no organized markets, no price fixed at any level and no credit facilities by the banks, no insurance mechanism, and no policy for wood. All these factors were identified as problems from production to consumption. To resolve all these problems at each stage, Forest College has developed a value chain model which is called as Production (P) to Consumption (C) model.

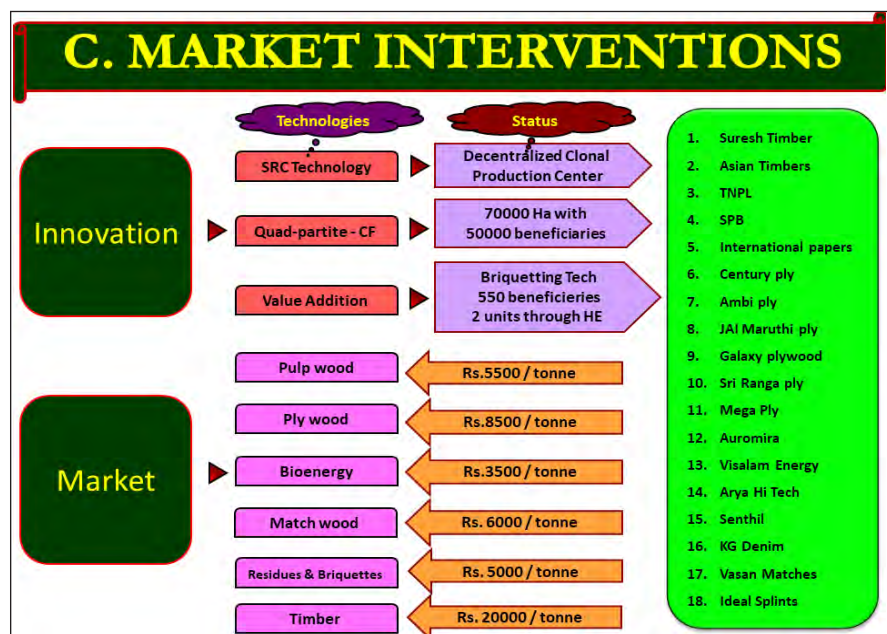




This value chain model intervened at both production and processing level problems through technological innovations and interventions. Secondly, at consumption level problems, it leveraged the organizational level, linking the people to the industry and all other stakeholders in a consortium approach. Thirdly as marketing intervention, to facilitate the price support mechanism, felling mechanism and transport mechanism so that the farmers at all stages were


benefitted. That model had been implemented elaborately from 2008 onwards initially with three industries — two paper industries and one match industry and today it is working with more than 50 different industries. While leveraging all these models wherever possible, many problems were also experienced. This positive system enhances productivity through agroforestry and leads to profitability, and secures raw material to all those who are facing shortage. For technological interventions different technologies were employed which were named as industrial agroforestry intervention.

For industrial agroforestry, one of the technologies taken was developing the high yielding, short rotation clones to identify the variety, which was amenable to harvesting for 18 months onward for use particularly for paper industry. Trees could be harvested in months and not years. A high yielding short rotation clone was developed for *Casuarina*, MTP 2, and a hybrid clone with an average productivity of 150 to 200 tonnes/ha in a short period of 3 years i.e., productivity of 50 tonnes/year. Similarly, the eucalyptus and *Kadam* were also introduced. There were three new clones of *Tectona grandis* (Teak), which were amenable to harvest from 12 to 15 years or based on size from 18 inches to 24 inches of diameter depending upon the different utilization. Similarly, there is a need about the long rotation crops but higher value e.g., *Santalum album*, PNR 1 is the variety which is amenable to the farmers. In the context of dendro energy, there are three different things i.e, species based on the utility, species for direct combustion and even for gasification and for combustion. More than 12 species amenable for wide utility have been identified for external utility and also for the atmosphere power generation. Trees are also required for plywood industry. In this project, multi-functional agroforestry model has been developed. The multi-functional agroforestry is very clear, even small farmers in India, where more than 70% farmers are small farmers; are able to practice




agriculture/horticulture. Silvi-pastoral model, agroforestry-based natural farming, high-value plantation micro-forests, etc. were some other components of this project. Micro-forests which are basically the trees outside forests were primarily created for mitigating the climate change on the common property resources which may be government land and village land. A proven technology had been developed for species like casuarina, eucalyptus and neem. Stocks were generated through


AGROFORESTRY INSURANCE




1. Conceived and implemented through United India Insurance.
2. Innovative Attempt
3. Satisfied the policy requirement










Risk Coverage :
 Forest fire, Lightning, Animal Damages,
 Flood, Storm, Cyclone,
 Riot, Pest, Diseases,



Premium – 1.25 % and 1.60 %
Rs. 300 - 800



Prioritized Species:
 Casuarina, Melia, Eucalyptus, Ailanthus,
 Subabul, Gmelina, Dalbergia

mass multiplication and planting, productivity and harvesting technology was leveraged. During the process of implementation, 20 -25% of waste was generated, in the form of tree unused, which was used to make the value-added products like eucalyptus pellets and animal food, etc. Now the de-centralized facility for processing and preservation was being created. After post-harvesting, there was also the value adding to the wood and antiques. A facility had been created where the wood antiques can be created and sold in the domestic and also for the export market. There were three models for having the organizational intervention and linking the people e.g., Quad-partite model in which institutes, farmers, industries and the financiers were involved, similarly the Tri-partite model and Bi-partite model. Following these models, four to five timber industries were able to leverage the technology based linking for pulpwood, plywood contract farming, energy, matchwood, processed wood and timber contract farming so that the farmers will get the easy market access and the market supports. The industries were committed to the pre-determined prices to pay to the farmers. During the process of implementation of the project, there was experience of cumulative effect of the tsunami and cyclone and accordingly insurance mechanism was built in during this process. Seasonal procurement mechanism was introduced so that farmers could get different benefits. The whole process/project was started on 200 ha with only three industries and currently it is being implemented covering 75,000 ha of land area with 50 different industries. For all the industries, a MOU was signed and the continuous funding was ensured. Agroforestry was also promoted for tourism for small-, medium- and large-scale farmers. These were not created for resting or for recreation but the tourists will enjoy agroforestry models and the business in the ecological consortium. Three different models had been created. One was farmer's field model and the other was institute-linked model and the third one was public sector model.

Agroforestry tree consortium was established and all stakeholders of agroforestry became members. Annually a meeting was held for debating on the problems, based on the problems the issues were resolved through the technologies and continuous R&D. This was how agroforestry technologies were leveraged to develop a business opportunity. Currently, the stakeholders have 7 different technologies, starting from mini clone technology to briquetting technology, wood preservation, carving technology, activated carbon technologies to agroforestry tourism technologies. So far 150 Small and Medium Enterprises (SMEs) have been registered and 25 ultimately landed to business in the form of start-up companies. This model was not only successful for Tamil Nadu but had easy replicable potential across the country. The talk was concluded with a comment—“Only point is to identify the problem and resolve it through technology, organizational and marketing linkages which ultimately will leverage to the agroforestry business opportunity”.

Topic: Cacao Value Chain and Emerging Opportunities

Speaker: Alain A Atangana, CIFOR-ICRAF

Dr Atangana delivered his talk on “Agroforestry: Sustainable cocoa value chain and enhanced livelihoods in cocoa communities in Côte d’Ivoire”.

Cocoa beans are largest commodity in the global market. Most of the cocoa is produced in Côte d’Ivoire, Ghana, Nigeria, Cameroon and Indonesia. Cocoa contributes up to 15% of the country’s GDP and 39% of the exports in Côte d’Ivoire. The challenges in cocoa production varied from disease like cocoa shoot virus infection to child labour, low farmers’ income, climate change and deforestation. All these factors had affected the cocoa productivity and livelihoods of the communities in the region.



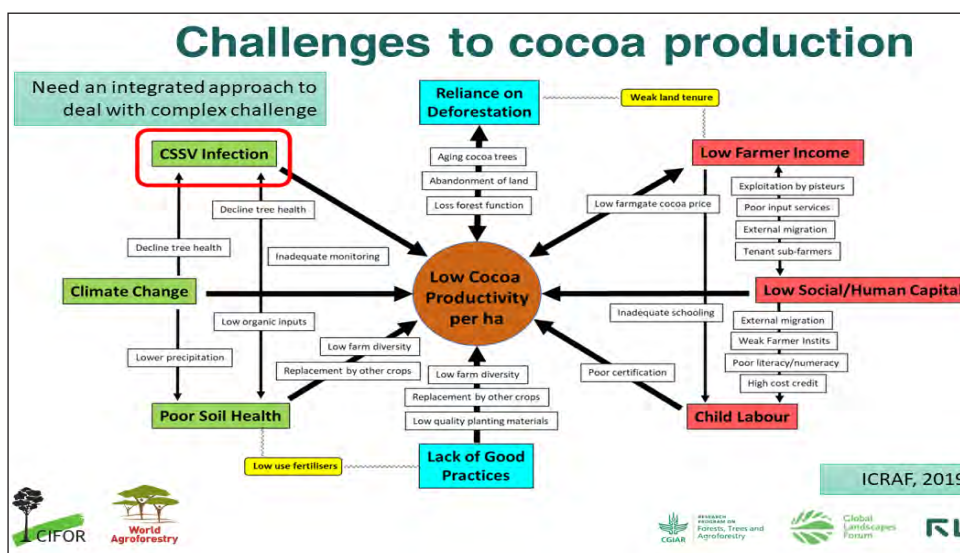
Alain A. Atangana

A total of 4.8 million tonnes of cocoa is produced worldwide and the average yield is 384 kg/ha, however, revenue from cocoa is very low. The communities relied on cocoa only and suffers from malnutrition particularly low Vitamin A. Cocoa has affected the environment. The area under cocoa has been ruined, and had impact on deforestation, have swollen shoot disease and land degradation which affects the cocoa value chain in Côte d’Ivoire and Ghana.

As a response from producing countries, strategies were developed to ensure sustainable intensification of cocoa farming by developing the roadmap for checking deforestation as there was a growing interest from private sector to support sustainable and inclusive supply chain of cocoa. In Côte d’Ivoire and Ghana, initiatives have been taken to reduce the deforestation and to create green community landscapes. One strategy was cocoa agroforestry which was a viable option to sustainably improve and diversify income by creating a resilient landscape. Public and private partnerships developed a project as a vision for change which was for the biomass. This was a four years project submitted to forest department for future

Alain A. Atangana
Scientist
Tree Crops Agroforestry Systems
CIFOR-ICRAF, Côte d’Ivoire

Dr Alain A. Atangana is Scientist-Tree Crops Agroforestry Systems with ICRAF since July 2019. Based in Abidjan, Alain is responsible for planning, implementing, and monitoring smallholder agroforestry systems for a suitable and equitable rehabilitation of cocoa landscape in Côte d’Ivoire and in West and Central Africa Region. Alain holds a PhD in Forest Sciences from Université Laval, Québec. Before joining ICRAF, he was postdoctoral fellow (Agroforestry) with University of Alberta, Edmonton, and Université Laval (Plant Sciences), both in Canada. He has several years of experience in working on agroforestry and tree domestication in the humid tropics of Africa.



which was funded by BMZ and also SCOLUR which was funded by GEF and FAO.

CARE-DEFOR project focused on agroforestry for sustainable cocoa value chain, resilient landscapes and enhanced livelihoods in cocoa communities. The objective was to improve and sustain through agroforestry the livelihoods of cocoa-

producing communities while restoring degraded cocoa landscapes. Participatory approach was followed. At the first stage relevant stakeholders including principal beneficiaries were mobilized and engaged. The second step was to co-develop and deploy profitable agroforestry models engaging farmers and last step was to unlock opportunities to improve the livelihoods of cocoa communities. The main focus point was to develop income generating activities based on products developed from cocoa forestry farms for rural women and youth.

Public and private partnerships

Ongoing projects on degraded cocoa landscape restoration in Côte d'Ivoire:

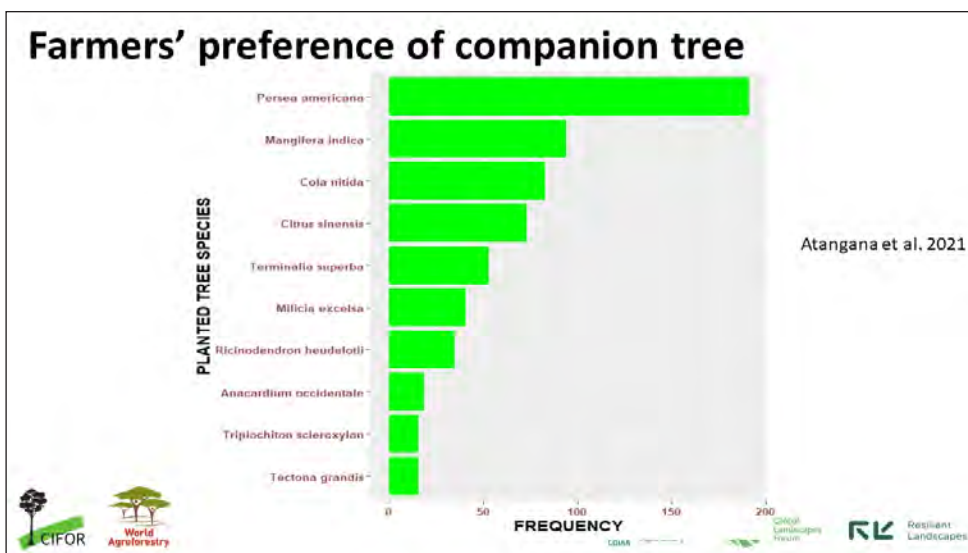
- **Vision for change: Mars**
- **CARE-DEFOR: Unilever**
- **Forests4Future: Submitted to BMZ (Advanced)**
- **SCOLUR: GEF**




To develop profitable agroforestry products value chains, first step was to carry out survey to identify suitable trees that could be integrated in cocoa farms as per farmers' choice. Second step was to develop market for agroforestry products after the market surveys. As a result of the survey carried out almost three years ago, a list of trees preferred by the farmers for inclusion in cocoa farms was prepared starting from avocado to teak. This was to facilitate the implementation of income generating activities. The beneficiaries were selected and the project ideas were mapped. The women and men had the same approach to select the trees. Workshops were conducted to create business plans for beneficiaries and to implement income generating activities to backstop the farmers.

Dr Atangana shared some of the examples of the products from agroforestry. Some products and by-products were made from seeds of *Ricinodendron heudelotii* (Akpi). Extraction of the kernel of *Ricinodendron* was very difficult and was done by women by trying to crack the kernel using a knife. Industry people were contacted to develop a machine which was suitable to extract the kernels by the farmers. Other example was of *Garcinia kola* (Petit cola) nuts. The price of 1 kg of *G. kola* nut was from 800 to 1500 West African CFA Franc (F) which was more than the cost of cocoa as it was sold at around 800 West African CFA Franc/kg. Nuts were used for manufacturing of beverage and seed powder was sold in market in the region. Another example

was of *Tieghemella heckelii* (Makore) which is used in cosmetics. Oil was extracted from the seeds of the fruits mostly by women only. About 2-3 kg of oil could be extracted from 5 kg of nuts. The seeds were sold around 250 West African CFA Franc and the oil was sold between 5000-6700 West African CFA Franc/kg, which



was more than the price of 1 kg of cocoa. Thus, just introduction of 1 kg of fat could enhance the income five times than that of the income from cocoa. There is a possibility of developing similar kind of value chains in Asia-Pacific also, as cocoa is cultivated in Southeast Asia mainly in Indonesia. The cocoa is the shade crop and full-sun mono-cropping is not possible. Thus, while identifying the trees, apart from shade the trees should have other benefits and provide some products which had a market and food value which has farmer-driven approach to create profitable business.

Concluding Remarks of the Session

Dr Feliciano Calora Jr., Chair, concluded the Session 3. He congratulated all the speakers for their presentations and sharing the information pertaining to technologies, innovations about mapping programmes, value chain, micro-forests, clonal plantations and use of indigenous trees. In his own words “It was interesting to see the presentations on agroforestry as an option to sustainably improve the diversity, income and in relation to the resilience”.

Session 4: Panel Discussion on Regional Priorities (Research Areas, Capacity Development, Regulatory Policy Development & Public Awareness, and Possible Partnerships) to Achieve SDGs

Co-Chair: Dietmar Stoian, CIFOR-ICRAF

Co-Chair: Helen Wallace, Griffith University

Rapporteurs: Atul Dogra, CIFOR-ICRAF and Archana Singh, CIFOR-ICRAF

Dr Devashree took over as moderator and welcomed the participants to Session 4, which was a panel discussion on regional priorities, mainly considering into the research areas, capacity development, regulatory policy development and policy awareness and possible partnerships among the countries. For this session there were two Co-chairs — Dr Dietmar Stoian, Lead Scientist Value Chain, Private Sector Engagement and Investment, CIFOR-ICRAF and Prof. Helen Wallace, Professor in Agricultural Ecology, Griffith University, Queensland, Australia. The detailed programme of the session is given below:

| Topic | Speaker |
|--|---|
| Priority Research and Innovation | Mi Sun Park, Seoul National University, Republic of Korea |
| Applications of Biotechnological Tools | Taichi Oguchi, University of Tsukuba, Japan |
| Developing agroforestry value chains from the perspective of small-holders and small and mediums enterprises | Dietmar Stoian, CIFOR-ICRAF, Nairobi |
| Financing Smallholders and Small and medium-sized Enterprises (SMEs) | Harsh D. Kulkarni, Vice President, ITC, India |
| Agricultural innovation system perspective in communication and public awareness | Martina Spisiakova, APAARI, Thailand |

Topic: Priority Research and Innovation

Speaker: Mi Sun Park, Seoul National University

Priority research and innovation was at the panel discussion on regional priority to reduce pollution as per SDGs of the United Nations. Working in the field of international forest policy from Seoul National University, Dr Park shared her opinions about the priority research and innovation in agroforestry. Based upon her background of working on the forest policy and environmental education, she had been conducting the research on agroforestry with a focus on the policy analysis and particularly on research and policy of the non-timber forest products. It was one of the examples of a systematic review of agroforestry research focusing on ecosystem services in Asia-Pacific region.



Mi Sun Park

She shared some of the results focusing on the field of agroforestry products particularly in South Korea. Wild-simulated ginseng (WSG) was highlighted and their research group conducted systematic review to find out the global trends of research on wild-simulated ginseng. This methodology was applied for identifying the research need or in identifying the stakeholders in agroforestry. Currently, work was going on for bringing out a special issue on systematic approach to agroforestry being practiced in Asia. This special issue will include

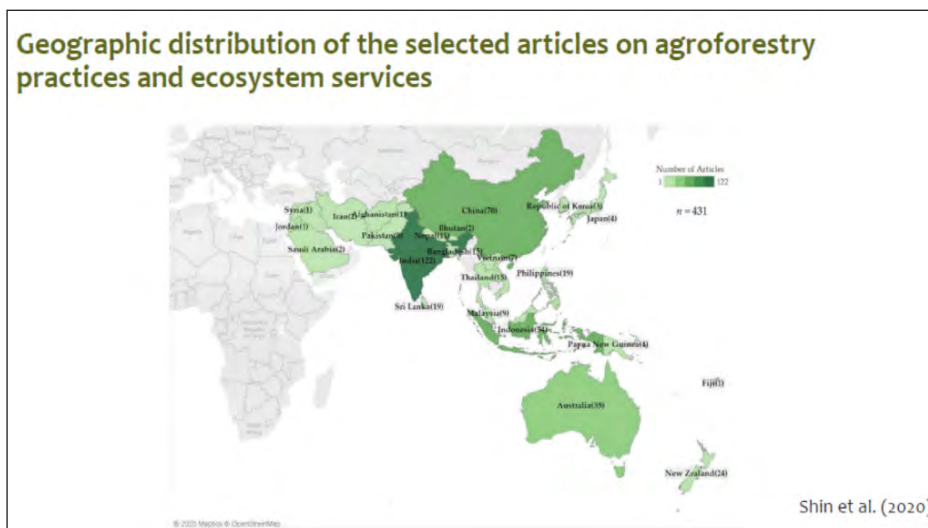
their systematic review on agroforestry and ecosystem service in Asia-Pacific region. The purpose was to define how agroforestry research handles multiple solutions.

In this systematic review, the geographical distribution of selected articles on agroforestry related to ecosystem services were included. It was found that in India and China, lot of research had been done related to role of agroforestry in ecosystem services. Silvoarable system was found to be a dominant agroforestry practice for agroforestry research in this region. Comparison of this practice that followed in Asia and European country revealed a different trend. Ecosystem services were also measured through academic research and it was tried to distinguish or divide these practices in several categories. The plantation crop combination and tree management practices were very dominant. Soil formation and habitat for species were the focus research topics in agroforestry and ecosystem services in Asia. Based on these results about agroforestry research in Asia, the priority in knowledge and agroforestry research which needed to be changed could be analysed.

Mi Sun Park
Associate Professor
Seoul National University
Republic of Korea

Mi Sun Park obtained a PhD in Forest Policy from University of Göttingen in Germany. Her research interests include governance/regime discourse and communication, policy strategies and instruments, policy integration, international cooperation and traditional knowledge in forest policy. Currently, she works as a Coordinator of Research Group — Traditional Forest Knowledge and a Deputy Coordinator of Research Group — Forests and the Media from International Union of Forest Research Organizations (IUFRO).

What kind of knowledge is needed for facilitating the agroforestry activities in Asia? Knowledge can be divided in three types especially in public policy. The political knowledge related to political know-how, the scientific knowledge research-based knowledge and practical implementation knowledge is the professional field experience related knowledge which are interconnected in agroforestry related activities. There is a need to consider the science of policy interface and integration among different sectors. SDGs presents integrated relationships among different sectors, therefore, the function and role of agroforestry to achieve SDGs are important issues to consider. Concept of agroecology was discussed to highlight the holistic integrated approach. Agroecology includes ecological and social concept and principles to design and manage sustainable agriculture in food system. The major elements of agroecology which need attention are diversity, co-creation of sharing of knowledge, efficiency, recycling to resilience, human and social values, culture and tradition, responsible governance, and circular and solidarity economy. There were relatively a few researches on the culture service over agroforestry. More attention can be given to the culture service and the linkage created in the concept of agroecology.



The other aspect was related to innovation and it has to be seen what kind of change was necessary — new high or advanced technology in knowledge and the traditional knowledge. Like the concept of agroecology and agroecology and green economy, skill economy, and bioeconomy can also be considered. Bio-economy is the knowledge based on production and use of our

biological resources to provide products in all economic sectors including agroforestry sector. Under the concept of bio-economy, use of biotechnology was amplified and in using the biotechnology, the aim was to bring economic output but the environmental sector part and the social part were also considered. Biotechnology is application of science and technology to the living organisms. There were three elements of bio-economy. In biotechnological knowledge, the new process of producing the range of agriculture products was considered and at the same time one could consider renewable biomass and integration across applications.

International agroforestry cooperation

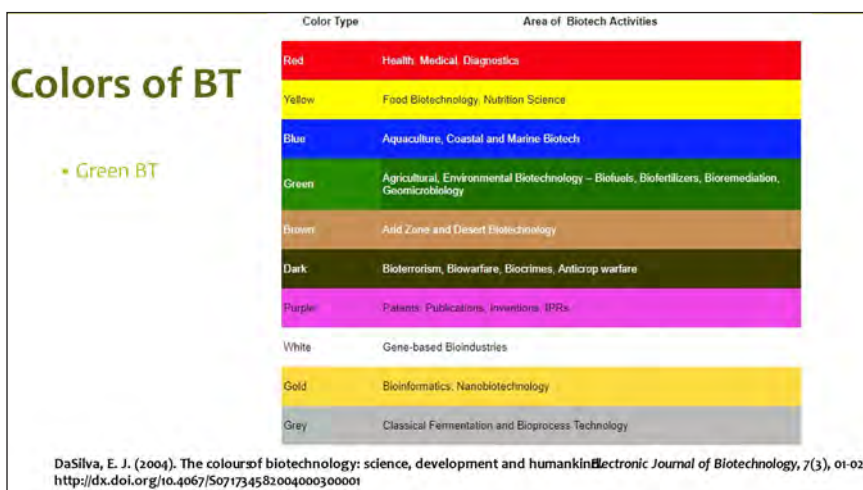
- ODA projects on Agroforestry
 - Policy guidelines
 - The ASEAN Guidelines for Agroforestry Development
 - Collaborative research
 - AGROMIX project in Europe (<https://agromixproject.eu/>)
- Agroforestry and Mixed Farming:
Participatory research to drive the transition to a resilient and efficient land use in Europe



The bio-economy was based on biotechnology and the biotechnology could be multiplied in different colours as shown in slide — red biotechnology, white biotechnology and green biotechnology. The green biotechnology included agriculture, forestry, integrated agroforestry and the energy sector related to agroforestry. In white biotechnology, agriculture product can be regarded as house of tools and can be used for improving health condition and then in the red biotechnology, the multiple colours of biotechnology in agroforestry can be considered. Through using the biotechnology, value can be added to the agriculture and agroforestry activities and their products in the process of producing and trading.

Another example of assessment of agroforestry residue potential for the bio-economy in the European countries was shared. The figure showed the absolute quantities of local substances available from bio-economy potential of agroforestry residues. This was one trial to give new values to our agroforestry. The other part was the traditional knowledge as already mentioned. Being a member of IUFRO Working Group on Traditional Forest Knowledge and coordinator for 5 years, she regarded traditional forest knowledge as a huge quantity of knowledge and practice related to forestry and agroforestry. Using the traditional forest knowledge, value can be added to the agroforestry products.

Dr Park also discussed about globally important agricultural heritage system (GIAHS) by FAO. This includes the value of biodiversity and the traditional knowledge in culture service or ecosystem service of agroforestry. A link can be developed between GIAHS and the geographical indicators to identify and highlight the value of agroforestry products.



Finally, she concluded her talk by highlighting the concept of cooperation. It can be the priority and it can be the innovation. Agroforestry projects, agroforestry policy and guidelines in Asian countries are well-known examples of cooperative activities and research. Success of the collaborative research is AGROMIX project in Europe was also discussed.

Topic: Applications of Biotechnological Tools

Speaker: Taichi Oguchi, University of Tsukuba

Dr Taichi Oguchi had worked on the tree biotechnology research. His target research was in typical plantation forestry such as eucalyptus and poplar. Climate changes and over-consumption of the resources is one of the major factors causing a change in the forestry sector. He opined that the forest resource is not infinitely available, there is a need to consider the renewable and non-renewable carbon resources. Woody biomass is a candidate for alternative carbon resource. Merit of the woody biomass is that it has no competition with food/feed. Forests provide the largest amount of biomass on lands. There are well established forest management techniques for kind of plantation forest trees and forest systems. Some of the important challenges for woody biomass production are decreasing area in potential forestry due to industry, the climate changes, high-cost use as alcohol or the material for chemical product, and difficulty in the conventional improvement.

Transgenic technique is a powerful tool to improve trees. Woody plant is a longer answer for long generation time on large sites. Issues like high allogamy (outbreed) and diversity on the genotype makes it really difficult to improve by conventional crossbreeding. Advantages of applying transgenic technology on trees are relatively higher than in cropped front.

He shared some of his biotechnological research on trees especially eucalyptus and poplars. The target traits were salinity tolerance, cold tolerance and improving woody biomass properties. To enhance the salinity resistance in forest plants, genes from halophytes were used. For reducing the salinity stress in eucalyptus, McRBP gene was introduced which was derived from ice plant — a halophyte. This increased the biomass productivity by 60% in comparison to the conventional tree grown in the moderate stress conditions.

Another work was shared on cold stress tolerant transgenic eucalyptus, harbouring gene AnDES9 which was derived from a cyanobacterium, *Anacystis nidulans*. Eucalyptus is for warm

climate and improved cold stress tolerance was expected to expand the potential for the plantation area.

Improved woody property would expand the biomass utility. Plant biomass use of alcohol was another chemical product as limited, such as sugar cane or the corn. Woody biomass is in the largest quantity on land and the cost of the processing is too high to use but it does make difficult to use alcohol as the chemical. There is an enzyme which improves the utilization of ligno-cellular biomass. Transformation of this design



Taichi Oguchi

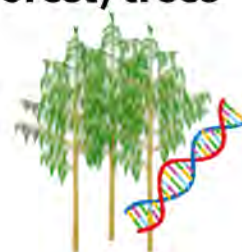
Taichi Oguchi
Assistant Professor
University of Tsukuba, Japan

Dr Oguchi has specialization is plant molecular physiology. He received PhD in Science from University of Tsukuba, Japan. Currently he is working on improving environmental stress tolerance and woody biomass properties of plantation trees by transgenic techniques. In addition, he has also been working on environmental risk assessment of biotech plants and developed expertise in GM detection and GM food safety issues.

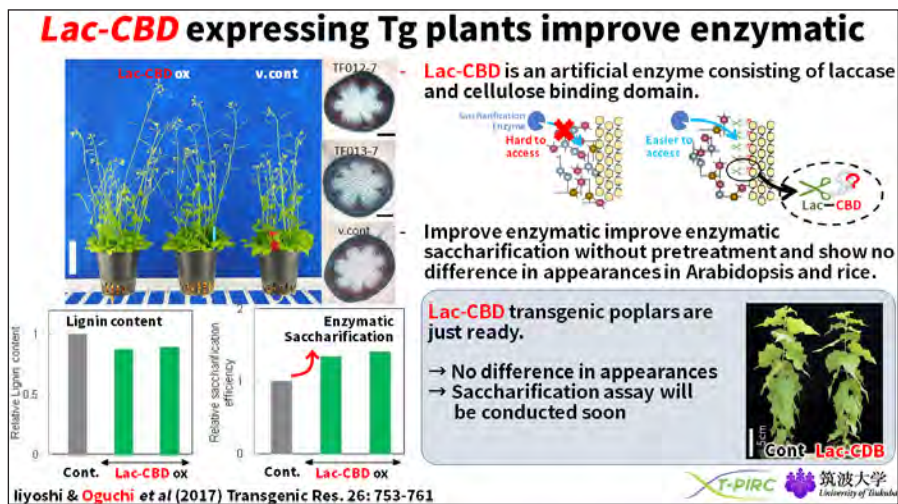
Transgenic tech on (plantation forest) trees

Difficulty in conventional breeding of trees

- Longevity and long generation time
- Large size
- High allogamy (outbreed)
- Diversity of genotypes, etc.



→ Advantages of transgenic tech on woody plants are relatively higher than crop plants.



enzymic scarification does not affect appearance but only the strength of the plant. Transgenics are accepted globally. Practical use of the GM plantation forestry is extremely important. Large part of the biosafety experience for GM crops are applicable for forestry trees. Commercial plantation of the transgenics was approved in Brazil in 2015. A profile in Brazil was a milestone for using

transgenic tool on forestry tree, but continuous scientist communication activities are required to gain the widespread public acceptance.

Genome-editing on trees was also discussed. Genome-editing might be treated differently from the current GMO regulation and might be exempted from the GM regulation in some countries. It is desirable in near future to establish genome-editing technique in forest trees without transformation. He ended his discussion on the note that there are many possibilities to explore useful genetic resources in forestry trees as compared to the major crops.

Topic: Developing Agroforestry Value Chains from the Perspective of Smallholders and Small and Mediums Enterprises

Speaker: Dietmar Stoian, CIFOR-ICRAF

The presentation was about the perspective of smallholders in small and medium enterprises regarding the development of agroforestry value chains.

Dr Stoian mentioned that it was important to see smallholders' households in a group and important individual members pursuing both joined individual goals. Indeed, individual goals were differentiated by aspects such as gender and age. For example, in a typical agroforestry system of the foothills of the Himalayas in Nepal, where women process paper made from the shrub which is a very important agroforestry species. There were different opportunities from the individual and household perspectives as regards to value chain. Livelihood strategies were perceived as households were very complex. There is a need of awareness about the dynamics underlying such livelihood strategies. And as much as an agroforestry option was important for the livelihoods of the farmers, their other activities were also to be taken in account as it was a joint approach of improving livelihood. Equally important were natural human resource, physical and financial capitals. There were different opportunities in the value chain, not only related to agroforestry production level, but also at the nurseries level providing quality planting material.

Smallholders are considered to be successfully integrated in value chains, truly benefitting from getting organised to small and medium enterprises (SMEs). It can also be a part of the contract farming system, but by and large it is organized as SMEs. Being organized, certain SMEs actually allows better access to finance,



Dietmar Stoian

technical assistance and other types of services. It also allows the training of the managers of such SMEs about development business skills rather than training each and every individual farmer. Therefore, SMEs have higher bargaining, negotiating powers with other partners in the value chain as there are many good examples from several countries where the organisation into an SME give smallholders a stronger voice in the political dialogue.

First of all being organised, SMEs allows for higher value adding and that could be linked to processing *e.g.*, mango from Thailand, durian from the Philippines. It could also be different type of labelling *e.g.*, there could be different types of certifications that are usually much easier to be paid for by an enterprise rather than the individual farmer. There could be different types of special attributes supporting value addition. Important aspect is economics of sale. Farming inputs could be seeds, fertilizers, joint investments in infrastructure, machinery and equipment that individual farmer could not easily afford and also the joint marketing. By bulking significant volumes, farmers usually can negotiate a better price. There are different types of linkages between SMEs and other value chain actors including large agro-food companies. This allows recalling embedded services, services of technical, business and financial nature that are provided by large companies to SMEs. It also allows different types of mechanisms to share benefits or risks. One of the examples of shared interest are UK-based financial services provider that provides access to soft loans to the organised producers in the form of SMEs activities of those of accreditation and certification.

Under-explored linkages between landscapes and value chains were specifically mentioned. By default, many landscapes are home to multiple value chains. Landscape has not only a bio-physical existence, but also a socio-economic environment. The value chains might have their origin or the endpoint or midpoint in the landscape and allow diversified opportunities to generate employment and income, adding value, and linking supply and demand. From the agroforestry development perspective, it is important that there is an environmental and social footprint of those value chains and usually such a footprint is saved. There are multiple stakeholders in the value chain and outside of the value chain, may be the capital that might extend not only to business partners or local government but also to certain kind of providers for technical, business and financial services. Generally, while looking at both public and private policy environment, basically opportunities are looked into for public-private partnerships in the joint investments for both blended finances.

Dietmar Stoian

Lead Scientist
Value Chain, Private Sector
Engagement and Investment
CIFOR-ICRAF, France

Dietmar's background is in value-chain research with a livelihoods perspective in Latin America, Africa and Asia. He has a keen interest in interdisciplinary research at the interface between biophysical and social sciences and achieving impact at scale through partnerships with governmental, non-governmental and private-sector organizations. Over the past two decades, he has been advancing research and partnerships in relation to landscape management and restoration involving agroforestry systems based on cocoa, coffee, banana and other tree crops; community stewardship of tropical forests; and, more recently, sustainable food systems.



Small and medium enterprises and agroforestry

- Organization of smallholders into small and medium enterprises (SMEs) → successful VC integration
- Better access to finance, technical assistance and other services
- Targeted development of business skills: SME managers, rather than individual farmers
- SMEs with higher bargaining power
- SMEs with stronger voice in the political dialogue




This was actually an illustration to explain that how a very nice agroforestry landscape can be linked to fruitful value chains because it is including the portfolio approach to the development of value chains for different markets. For examples, fuel wood, staples, livestock might be for local markets. There might be other products such as timber, fruits and livestock to the

regional markets and products like cocoa, coffee, nuts, honey, etc. for global markets. The important part is that there are diversified opportunities differentiated by gender, by age and other sort of factors that actually allows for different types of household members and households to be part of multiple value chains.

Thus, SMEs do actually allow for successful integration of smallholders into value chains, and this was one of the key take home messages. He concluded his talk on the point that it is important to look into the leverage for the response, finance, and investments that would allow linkages between those areas where investments go like energy, waste, and transport sectors to the agroforestry sector. There is space for doing agroforestry interventions usually very close to urban market. There is a need for increasing tree cover in those areas which will not only be providing environmental services but also new and additional opportunities for generating employment and income in those areas.

Topic: Financing Smallholders and Small- and Medium-sized Enterprises (SMEs)

Speaker: Harshkumar D. Kulkarni, ITC Ltd.

Dr Kulkarni discussed mainly three points in his presentation: (i) agroforestry – the experience which he gained when worked in ITCs plantations department in the last 26 years, (ii) financing smallholders and SMEs enterprises, and (iii) the new agroforestry proposals. In his opinion, the wood-based industry cannot continue to depend on the existing natural forests in view of fast decreasing forest cover in India because (a) captive plantation on degraded forest land is not permitted under the current forest policy, and (b) India does not have a vibrant private market for timber. At least one of the above is considered essential for securing global competitiveness of the Indian pulp and paper industry.



Harsh D. Kulkarni

The approach and the journey from scanty to plenty in their areas was a triple bottom line approach of environmental, economic and social aspects and setting up of the institutional mechanism through Society of Elimination of Rural Poverty, the women empowered mandals Samakhyas, the NGOs and the company itself. Financing smallholders or the tribes and the private industry, partnership with private farmers for plantations for stewardship council certification and carbon credits were the next steps. The programmes for the above were to raise plantations, implement watershed, women's empowerment, secondary education, animal husbandry, health and sanitation.

Few years ago, the people in the core area of the mill were besieged with the problems like perennial floods from the river "Godavari", crop losses due to pests and diseases, anti-social problems, fluctuation in market prices for agricultural crops and infertile soil, etc. The negative trend was reversed with plantation under R&D and agroforestry plantations. To start with, 4.67 million seedlings were distributed to the farmers for 5 years and that covered nearly 2800 ha. Subsequently, NABARD was requested to provide finance for raising plantations and nearly 7441 ha area was covered. But productivity of these seedling-based plantations was very low e.g.

Harshkumar D. Kulkarni

Consultant and Former Vice President, ITC Ltd., India

Dr HD Kulkarni is a free-lance consultant on Forestry & Environment. He has served ITC Ltd Paperboards and Specialty Paper Division for more than 26 years and retired as Vice President, Plantations. He has undertaken tree improvement research and released 107 clones of eucalyptus, 15 of casuarina and 12 of subabul enabling promotion of more than 165,000 ha plantations under agro-forestry/farm forestry. Dr Kulkarni also registered the Forestry CDM project in UNFCCC and got Forest Stewardship Council Forest Management Certification for agroforestry plantations. He is actively working on agroforestry and carbon neutrality aspects and guiding various industries on emission offset/neutralty programme in India and abroad.

6 metric tons/ha/annum or around 40-42 tons over long time of 7 years. Such low productivity was not economical to farmers as an alternative farming option and agroforestry, farm forestry was considered a failure at that time. This was the scenario before the tree improvement program was started.

At that time, plantations were done at a very close spacing and

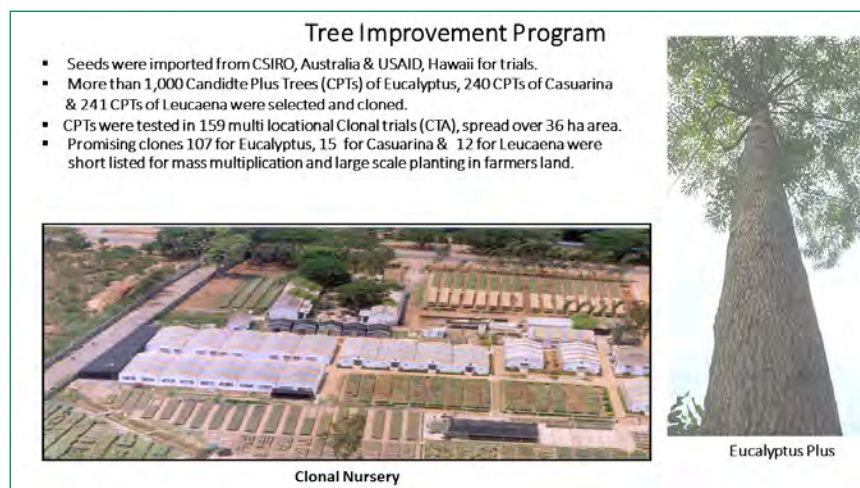
called as energy plantations. There were a lot of insect-pest attacks and termite damages to plantations. Because of leaf blight disease, the plantations were not successful. The local landraces, known as Mysore Gum was planted but the yields were very low due to non-availability of good seeds and use of primitive nursery practices for raising plantations. There was no knowledge on matching the species to site and primitive nursery and silvicultural practices in raising plantations. And above all, there was narrow genetic base of *Eucalyptus*, *Leucaena* and *Casuarina* which were the main pulp wood species.

The company started pulp wood improvement programme in 1989 for improvement in productivity for securing raw material on sustainable basis. The main focus was on genetic improvement of planting stock and improvement of package of practices. In addition to increase in productivity (at least 3 times), the programme also focused to reduce rotation age, adoption of suitable spacing, and develop disease resistant, wind and drought tolerant clones. Site-specific clones were developed, improving silviculture and fibre traits for the internal customer perspective, the pulp mill. Package of practices were improved and social and farm forestry models were developed, research programmes were initiated and then taken to field to cultivate *Eucalyptus*, *Leucaena* and *Casuarina* species.

In the first instance, seeds were imported from CSIRO, Australia and USAID, Hawaii, USA, for trials. More than 1000 candidate plus trees of *Eucalyptus*, 240 of *Casuarina* and 41 of *Leucaena* were selected and cloned. These candidate plus trees were tested in 153 multi-locational trials spread on 36 ha area and 107 promising clones of *Eucalyptus*, 15 of *Casuarina* and 12 for *Leucaena* were shortlisted for mass multiplication and large-scale planting in farmlands. Macropropagation method was adopted and around 500 womenfolk employed to do cutting, preparation and set the cuttings in root trainers for rooting in mist chamber. The plants used to get ready from cutting to the stage of planting in around 6 months. As compared to seedling-raised plantations productivity, these superior clones were giving >25 tons productivity/ha/annum.

Clone 288 of *Eucalyptus* is called an ideotype as it met all the growth and pulp mill fiber requirement parameters. Hybridization of *Eucalyptus* species lead to urograndis, teretigrandis hybrids and trials were conducted and spectacular hybrid were developed. In 4 years, it attained nearly a 100 cm girth at breast height (gbh). The genetic \times environmental interaction trials were also laid out on the red soils, black soils and refractive soils.

One important factor to be taken into consideration was that mostly the fertile lands were used for agricultural crops and refractory sites for the plantations and therefore, need was felt to develop the site-specific clones. The area where ITC had tried nearly 80 clones of *Eucalyptus* on a site which had nearly 10 pH and chlorosis was observed. One group of clones which was very healthy and tall had adapted to the site. Nearly 23 clones were short-listed for such refractive sites. The irrigation and rain-fed trials were also done. It was found that nearly 45% more wood could be obtained by irrigating the plantations. In one year, the



FSC FM Certification

FSC FM Certification
for 22565 ha plantation
of Social and Farm forestry
with
No of Farmers = 24955
Species = Eucalyptus & Casuarina
Partners:
ITC Group Manager
+ Vanikaran Sangha
+ Tribal Farmers

CDM Reforestation project
Area = 3019 ha
No of Tribal Farmers = 3000
CER's issued by UNFCCC = 400,000



trees attained nearly 7 m height (in seven years nearly 40 m height) and the girth was built up in the second year onwards. In the 4th year, the harvest of plantation was done based on CAI and MAI curve. Similarly, clones of *Eucalyptus*, *Casuarina* and *Leucaena* were developed. Some of the farmers owning the farmland were aggregated who left the lands unplanted, either for agriculture purposes or for the trees. Nearly 100 acres belonging to 4-5 farmers were covered under superbly grown clonal plantation along with paddy, fishery, apiary, medicinal plants and root stock regenerated forest species under

biodiversity conservation plan.

From 1992-2005, block plantations at 3 metres spacing were developed and agroforestry models were adopted in which various crops were planted. Clonal plantations require less land and do more carbon sequestration as compared to seedling crops. The best quality wood, paper and paperboard were produced and Forest Stewardship Council – Forest Management (FSC FM) Certification for 22,565 ha plantations was obtained and also a CDM Reforestation Project for 3000 ha was registered with United Nations Framework Convention on Climate Change (UNFCCC). Certified Emission Reduction (CER) of 400,000 were issued by UNFCCC for the CDM forestry project. Nearly, 24,955 farmers were involved in FSC FM certification. About INR 5000 crores were earned from 167,744 ha plantations and labour employment was generated to about 75 million person days and 2455 million tonnes of carbon was sequestered.

Forest Certification for ITC Plantations

- FSC C-o-C
- &
- FSC FM certification



To contribute into the SDGs to a certain extent, ITC had financed agroforestry plantation for smallholders. A revolving fund was created at ITC for providing incentives to farmers, for taking apprentices, for certification, encouraging people to start clonal nurseries to meet the demand of 200 million clonal saplings/year. In due course of time, private nurseries sprang up and it became a perfect business for SMEs. Consequently, the paper industries wood requirement of 100,00,000 metric tonnes/year could be met very easily. Productions of root trainers by SMEs became a new business in India. Polyhouse, micro-irrigation increased the business of SMEs many folds.

There were around 3000 plywood industries as SMEs in India with small and outdated machinery. Financing is required for upgradation of these SMEs so that they could be used and be efficient users of the wood. Linking plywood industry with the agroforestry plantations will benefit farmers, industry and help in many ways such as for certification and for carbon credits. Financing for certification of agroforestry plantation is a must. Carbon financing for the agroforestry plantation will go a long way. There was a new proposal of 1 million ha plantations, which was in circulation with 250,000 farmers and the wood asset value of INR 105 lakh crores and 450 million persons employment could be generated from that besides capturing 234.69 million tonnes of CO₂. He concluded that this “fast wood” agroforestry experience may serve as an example for bringing in ‘Brown Revolution’ in India.

Topic: Agricultural Innovation System Perspective in Communication and Public Awareness

Speaker: Martina Spisiakova, APAARI

Ms Martina started her talk by sharing a story. She visited her relatives in a very remote village in central Europe, after a gap of three years or so, and was absolutely shocked by the level of deforestation in that area. A lot of forest has gone and as per her relatives, this was the worst ecological disaster in the village history. In Europe, of course there was not tremendous pressure from the European Commission to save forest to use them in a sustainable way. On deep exploration and after contacting village chief and politicians, it was observed that there was lack of awareness of agroforestry and forest management practises among the people, among the farmers themselves and the foresters. There was also a lack of empowerment of local people and motivation to push for change.

She focused in her presentation on the last aspect *i.e.*, awareness. Lack of awareness could really inhibit understanding of the need for action, the choices that people had available and also the ability to collaborate with other stakeholders involved. In contrast, improved public stakeholder awareness could act as a trigger for motivating and supporting collaborative action. This could also be a tool as well as an endpoint at the same time. It was noted that achieving and maintaining a good level of awareness, raising and demonstration activities in relation to farming and forestry had been identified as an environmentally and socially beneficial outcome on its own. Another very important area was the role of networks and engaging different actors to raise awareness and build capacity of these networks of the people, of the local communities in order to really push for change.

There had been over dependent on conventional agricultural and forest management methods. There was another quick knowledge of sustainable approaches which were also restricting the interest of

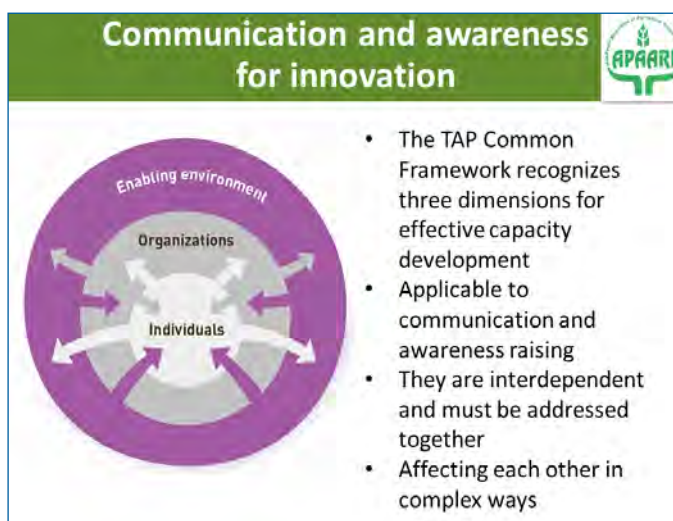


Martina Spisiakova

Martina Spisiakova

Knowledge Management Coordinator,
APAARI, Thailand

Ms Martina Spisiakova possess rich experience in knowledge management (KM), has served organizations such as the International Fund for Agricultural Development (IFAD) in Rome, Italy; United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) based in Bogor, Indonesia; and APAARI in Bangkok, Thailand. In APAARI, she as Knowledge Management Coordinator, is responsible for the Association's KM and partnership programme, as well as the development of APAARI Strategic Plan 2017-2022. Ms Spisiakova is a Slovak national with over 18 years of international experience in knowledge and network management, South-South Cooperation, programme management, training, communications, and monitoring, evaluation, and learning (MEL) in the context of rural and agricultural development.



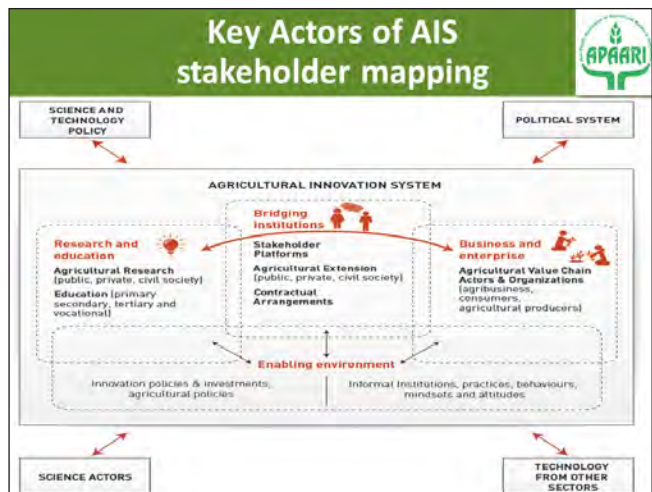
policymakers to advance agroforestry in the policy agenda and this could have a negative effect on the amount of investment that was dedicated for research dissemination, market information, which is all very crucial in order to improve the adoption of agroforestry practices. But there are many other factors also that are preventing agroforestry adoption.

Ms Martina briefly summarized all the benefits of agroforestry for which there is a need to raise awareness amongst the people. We all need

to reflect whether our efforts to demonstrate the impact of agroforestry practices and interventions on agricultural productivity, ecosystem services and human well-being are being effective. One of the core principles of sustainable forest management is that it reflects a diverse range of societal values in reference to forest conservation, including agroforestry. She also discussed an agriculture innovation system perspective, which is the core when communication awareness strategies or capacity development programmes within agroforestry are designed. There is a need to think about the system, about the different actors, that part of the system and how the system works. Innovation is crucial for agroforestry, as per earlier discussions. It is crucial to improve productivity, enhance livelihoods of smallholder farmers, reduce conversion of forests into fields for agriculture and reduce pressure on forests. An understanding of the agriculture innovation system, its structural and functional components are required. Structural component means the different actors that are part of the system infrastructure, institutions and the functional components means how they are operating and collaborating with each other. APAARI has been working a lot with the Tropical Agriculture Platform and a Common Framework on Capacity Development for Agriculture Innovation System (TAP-CDAIS).

Agriculture increasingly involves complex interactions among stakeholders at multiple levels. Innovation needs a system perspective. It does not mean only technologies e.g., variety, sustainable land management techniques and methods. The CDAIS recognises three dimensions for effective capacity development and it is completely applicable to communication awareness raising. One cannot just raise awareness at the individual level because it is not going to work. There is a need to address the three dimensions of the whole system at the same time — the individuals, the organisations and the institutions supporting the enabling environment. They are all affecting each other and, therefore, they need to be addressed simultaneously.

The linear model of communication of capacity development is just simply not working because we are operating in a very complex environment. There is a need to include not only researchers, farmers but also bridging institutions. There is a need to also look at the enabling environment as well as the different systems that are influencing this innovation system, such as political system. Facilitation is really the key which has to be used for fostering the synergies between these actors and have their capacity for collective decision making. Facilitation enhances interaction and relationships of individuals, organisations, and their social, cultural and political structures through this process of network building and social learning, negotiation, which is very important in building trust and overcoming resistance to change. Facilitation also requires specialised skills of individuals who can act as mediators in complex situations. So, there is a need to really go beyond the conventional role of extension agents, advisory services and communication officers, just to go that extra mile to integrate facilitation in this process.



Functional capacities are required to facilitate communication. The functional capacity is actually not technical knowledge but attitudes, behaviour or can be called as soft skills that are needed to successfully apply and coordinate other people capacities to achieve long-term development outcomes which also include effective communication and raising awareness. The capacities that are really needed to promote more innovation application and adoption of innovative processes and technologies by farmers, by land users, etc. include capacity to collaborate, reflect as learnt, engage in strategic and political processes that leads to the capacity to adapt and respond in order to realise the potential of innovation.

To facilitate outreach and awareness building, it has to be ensured that all stakeholders including the communities have access to the latest tools and information that support agroforestry adoption. Listening is a very important capacity and we should be able to listen to land users and other stakeholders, understand their needs, and need to engage them actively. They will trust and support the adoption, learning and collaboration.

She summarized that the communication and awareness raising strategies must integrate these points — the first point to map the different stakeholders involved in the systems, to develop a plan for two-way communication and agroforestry using communication mechanisms and approaches that respond to the needs and objectives of the range of target groups and also educational methods that are in line with the range of educational needs and learning styles of the stakeholders or target groups. There is a need to facilitate collaboration and help the stakeholders to work together, innovate and spread information, knowledge, values and goals.

Discussion during the Session

Chairperson Prof. Helen opened the session for discussion. Eulandy wanted to know specifically the implication of the agricultural crop with the tree crop of eucalyptus system.

Dr Harsh responded to the query and explained the results based upon different experiments on spacing carried out on agricultural crops as well as the trees with the help of CRIDA. Eight metres wide for the crops to be cultivated and the one metre alley cropping up two rows of *Eucalyptus* or *Leucaena* were found to be the best for planting. The area allotted to the agricultural crop was 75% , whereas for the tree crops it was 25% and from this 25% of the tree, a yield of almost 100 metric tonne was harvested in four years time and there were not very much crop losses. The idea of this agroforestry model was to secure food and economic security and therefore, in the areas where droughts and floods were common, this model was adopted. If the droughts and floods occur, the agriculture crops get damaged, whereas the tree stands and compensate the losses to farmers and thus, the risk is averted for the farmers.

Dr Veena Gupta wanted to know the species for any conservation activities. ICAR-CAFRI and CRIDA have been maintaining some of the elite clones in the gene bank in India but she wanted to know about conservation approaches other than the gene bank adopted for the agroforestry germplasm conservation. Dr Kulkarni replied that as a policy, company have conserved all the gene resources at three places so that if one place gets in to any kind of requirement than the other two places stand and from there, the germplasm can be procured. Moreover, all these clones have been shared with various institutes and have been taken for trials like Kerala Forest Research Institute, Tamil Nadu Agricultural University. Actually 100 clones were conserved over there, even by ITC for DNA finger printing work. There have been a lot of good efforts for conserving the germplasm, such as for *Milia dubia*, the FRI Dehradun has conserved the germplasm very well. For Popular, WIMCO has done a lot of work and popular clones are well preserved in the Rudarpur facility in India in their germplasm banks.

Another question in the chat box was pertaining to the performance and acceptance of exotic species while not promoting the local flora. Dr Dietmar Stoian was the first to respond. In his opinion, no doubt that exotic species were performing better but the native tree species had been providing an unexploited potential. Majority of tree improvement programmes focus particularly on the exotic species. The bottom line is that we really need to go for quality planting material, be it native species or be it is exotic.

Dr Kulkarni intervened by stating that they had promoted nearly twenty two indigenous species for plywood purposes. These twenty two species will be cultivated in twenty states of India. So there is a kind of awareness for growing the indigenous species apart from the exotics.

Dr Rishi Tyagi asked Dr Dietmar Stoian for a quick clarification about the efforts for conservation of agroforestry germplasm with the CIFOR-ICRAF. Dr Dietmar Stoian replied that CIFOR-ICRAF had a major tree gene bank at the headquarters in Nairobi, Kenya, but more local gene banks were in a couple of countries where they were working particularly on indigenous species. More than 200 tree species were in the tree improvement programme.

There was another question about bamboo to which Dr Vanita Barry responded saying that they had bamboo-based agroforestry systems in India. Actually, bamboo based agroforestry system was established under NABARD funded project and they had made this consortium with NABARD, the numbered and wood based industry and technological expert. The quality planting material was provided through the consortium and basically farmers were not interested to switchover to new agriculture crop. So liberty was given to the farmers to adopt whatever they were interested in, like some farmers were ready to intercrop floriculture under this bamboo-based agroforestry system.

Prof. Helen concluded the session and thanked all the speakers and organizers.

Closing Session



Co-Chair: Ravi Khetarpal, APAARI

Co-Chair: Shiv Dhyani, CIFOR-ICRAF

Rapporteurs: Sunil Londhe and Devashree Nair, CIFOR-ICRAF

Dr Devashree made a presentation of key draft recommendations compiled from different session with the help of rapporteurs of respective sessions. The refined key recommendations are presented in next section.

Dr Shiv Dhyani, stated that the two days were very informative and fruitful as diverse topics related to agroforestry have been covered. The networking is one of the important outcomes of the 2-day expert consultation among the participants from 27 countries which will be serving for longer period.

Dr Ravi thanked Dr Dhyani and appreciated the deliberations of the two days which were very useful, especially learning on various aspects of the importance of agroforestry *vis-à-vis* climate change and food security, how people achieved and scaling up of the successes of the agroforestry. The recommendations on moving from seasonal to permanent agriculture, which is a low hanging fruit and the need for fingerprinting of farming system to make spatially informed decisions, site-specific recommendations and market access, diversification of crops to improve livelihood and resilience were worth mentioning. He emphasized that there was a need to develop the partnerships with the ICRAF and CIFOR in their programme in future. He appreciated the excellent presentations on value chain, innovation and interventions. There were lot of deliberations on agroecology, bio-economy and awareness. In Asia-Pacific region, in terms of policies something had been done in some parts, however, much is needed to be done in the region. His thrust was on the following points to have recommendations related to regional priorities for regional collaboration and cooperation at institutional level and at country level; collaboration in the policy space; forest bio-security; international trade and trade barriers of the agroforestry products.

Finally, the APAARI, linking it with innovations system, discussed a lot on the capacity building. But there had never been developed a linkage between technical capacity with the functional capacity which were capacities to navigate complexities, capacity to collaborate, capacity for strategic policy positions. In future APAARI will be pleased to work on that with anyone working in agroforestry. Finally, he conveyed his special thanks to CIFOR-ICRAF for their partnership in this very important event. APAARI platform could be a wonderful platform for bringing people together and for right kind of advocacy and an outreach.

Vote of Thanks

On behalf of APAARI, CIFOR-ICRAF and on his own behalf, Chieh-Cheng LIN (Jack), APAARI, proposed a formal vote of thanks to all the dignitaries Dr Tony Simons, the Executive Director of CIFOR-ICRAF, Mr Vincent LIN, the Director General of COA Taiwan and Dr Ravi Khetarpal, Executive Secretary of APAARI, who presented the encouraging opening remarks to set the tone of consultation. He also thanked all chairs, co-chairs, speakers, panellists, rapporteurs and participants from 27 countries. He also conveyed

his special thanks to all the speakers and panellists who imparted their experiences and shared knowledge with participants and made interaction very vibrant in limited time, and responded to our request and accepted the invitation. He was also extremely thankful to all the participants from different categories, policy makers, research managers and researchers, administrators who took interest and spared time to participate in the consultation, despite the fact that they were located in extremely different time zones. Special thanks to all the rapporteurs who had done a wonderful job in recording the proceedings of each session. Also, special thanks to all the organisers who supported this consultation in one way or the other. He also thanked Dr Javed Rizvi, the Director of CIFOR-ICRAF Asia programme for his untiring efforts, who not only had agreed to organise this consultation in partnership, but also had guided in developing the technical programme and accomplishing it successfully by even working in odd hours from Toronto Canada. Sincere thanks were conveyed to Dr Shiv Dhyani, who had always been available to guide and provide valuable suggestions through discussion with Dr Rishi Tyagi in developing a vibrant programme. Drs Devashree and Archana Singh had been extremely helpful in arranging and coordinating the logistics for this consultation and conveyed his thanks to them. He was equally thankful to Ms Suzanne in Kenya for her efforts to take care of social media of CIFOR-ICRAF. Finally, he was thankful to all his colleagues in APAARI Secretariat who supported this programme to make it successful. Foremost thanks to Dr Rishi Tyagi who conceptualised and devised the concept and technical programme and partnership with Dr Rizvi, Dr Dhyani and Dr Devashree of CIFOR-ICRAF to organise the consultation and special thanks to Mr VK Sah for his support during the operation for the digital platform.

Key Recommendations



Agroforestry is an evolving science and signifies the importance of trees for products and for services. It is essential for converting land use into more sustainable natural systems. Agroforestry has a huge potential as climate smart agriculture, in climate vulnerable areas enhancing income and livelihood of smallholders. Smallholders can increase incomes with agroforestry while improving the ecological value of the environment. Although countries are taking measures for upscaling agroforestry without destroying forestry dimensions and deriving economic benefits, however, enabling policies are to be in place to maximize the benefits of research, technologies and innovations to the smallholder farmers. Of the 2-day deliberations during expert consultation on agroforestry, key recommendations emerged which are mentioned below:

Sustainable Development through Agroforestry

- A new paradigm of inter-sectoral planning and policy is essential for each country to scale up practice of agroforestry.
- Context-specific local farm innovations with farmers as core innovator and focused around different stakeholders, especially private sector engagement is needed.
- Landscape-based natural resource management with agroforestry is recommended to increase overall agroforestry system resilience.
- For successful and economically viable agroforestry, plantation needs to be done using advance clones, quality planting material, and efficient nursery management.

Enabling Policies and Scaling-up Investment

- Transformational changes through National Agroforestry Policies signify its importance in scaling up, bringing in investments and converging stakeholders to one platform, therefore, each country needs to have National Agroforestry Policy.
- Considering the decreasing carbon stocks from forest, agroforestry can help in carbon sequestration. Therefore, there should be carbon financing of agroforestry plantations and opening of a Carbon Registry for trading certified emission reductions (CERs)/voluntary emission reductions (VERs).
- National governments should also address the land tenure issues to promote and scale-up agroforestry to encourage particularly the women farmers.

Agroforestry and Entrepreneurship

- Biophysical similarity mapping, digital augmentation are future technologies for scaling-up, site-specific agroforestry that help inter-linking vital elements of complex smallholder farming systems transition.
- The Multi-chain Approach Portfolios, an agroforestry approach, suitably be adopted at national level to promote greater diversity of food tree species and crops on farms to enhance seasonal food resilience and diversify diets at local levels.
- Agroforestry business incubators should be linked to industries and markets in sourcing raw materials direct from farmlands, ensuring that farmers get the best prices for their tree products.
- Establishment of market-linked value chains are necessary to facilitate income generating activities for smallholders including women farmers in agroforestry.
- Understand the markets for agroforestry products and find the ways to reduce the risk for investors to help create market pull.

Regional Priorities (Research Areas, Capacity Development, Regulatory Policy Development & Public Awareness, and Possible Partnerships)

- Political, Scientific and practical implementation knowledge are interconnected, and their integration is essential for functions and contribution of agroforestry in achieving SDGs.
- Innovation in agriculture is not only just technology but also process, organizational forms, communication and awareness along with understanding of various actors and their roles in agroforestry.
- Inadequate knowledge of sustainable approaches restricts the interest of policy-makers in agroforestry development. There is a need of continuous scientific communication activities to gain widespread public consensus engaging institutions.
- Dissemination of knowledge, modern science, policy and communication-awareness are interlinked and synergy is the need for scaling up of agroforestry in the Asia-Pacific Region.
- Experience, lessons and successful cases on agroforestry should be documented which will help the region to promote agroforestry.

Virtual Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific (AFERSuLiF-AP)

Jointly Organized by APAARI and CIFOR-ICRAF

TECHNICAL PROGRAMME

Date: October 13-14, 2021

Digital Platform: ZOOM

Moderators: Rishi Tyagi, APAARI and Devashree Nayak, CIFOR-ICRAF

Day 1: Wednesday; October 13, 2021; Time: 11:00-14:15 ICT (Indo-China Time)

| Opening Session | | |
|--|---|---|
| Rapporteur: Swati Renduchintala , CIFOR-ICRAF | | |
| 11:00-11:10 | Remarks | Tony Simons, Managing Director, CIFOR-ICRAF |
| 11:10-11:20 | Remarks | Vincent LIN, Director General, COA |
| 11:20-11:30 | Remarks | Ravi Khetarpal, Executive Secretary, APAARI |
| Session 1: Sustainable Development through Agroforestry | | |
| Chair: Ravi Prabhu , CIFOR-ICRAF | | |
| Rapporteur: Atul Dogra , CIFOR-ICRAF Rapporteur: Raj Kumar Singh , CIFOR-ICRAF | | |
| 11:30-11:50 | Overview and Potential of Agroforestry | Shiv Dhyani and Javed Rizvi CIFOR-ICRAF |
| 11:50-12:10 | Agroforestry System – Food Security, Climate Mitigation and Rural Employment | A. Arunachalam, ICAR-CAFRI |
| 12:10-12:30 | Agroforestry: Innovations and Public-Private Partnerships | Ravi Prabhu, CIFOR-ICRAF |
| 12:30-12:50 | Agroforestry and Water for Resilient Landscape | Ramesh Singh, ICRISAT |
| 12:50-13:05 | Open Discussion | All Participants |
| 13:05-13:10 | Comfort Break | |
| Session 2: Enabling Policies and Scaling-up Investment in Agroforestry | | |
| Chair: S. Bhaskar , ICAR | | |
| Rapporteur: Archna Singh , CIFOR-ICRAF Rapporteur: Sunil Londhe , CIFOR-ICRAF | | |
| 13:10-13:30 | Need and Value of Policy: Learnings and Expectations from Policy and its Implementation | Javed Rizvi and Sunil Londhe, CIFOR-ICRAF |
| 13:30-13:45 | Innovative Strategies for Scaling-up Investment in Agroforestry | Helen Wallace, Griffith University Queensland |
| 13:45-14:00 | Agroforestry – a Climate Smart Agriculture Production System | Md Abiar Rahman, CIFOR-ICRAF |
| 14:00-14:15 | Open Discussion | All Participants |

Day 2: Thursday; October 14, 2021; Time: 11:00-14:15 ICT (Indo-China Time)

| Session 3: Agroforestry and Entrepreneurship: Lessons from Success Stories | | |
|--|---|--|
| Co-Chair: Javed Rizvi , CIFOR-ICRAF Co-Chair: Dr Feliciano Calora Jr. , DOST-PCAARRD | | |
| Rapporteur: Aqeel H. Rizvi , CIFOR-ICRAF Rapporteur: Swati Renduchintala , CIFOR-ICRAF | | |
| 11:00-11:20 | Mapping Spatially-explicit Roadmap for Scaling Agroforestry | Chandrashekhar Biradar, ICARDA |
| 11:20-11:35 | Agroforestry and Tree Outside Forest (TOF) Business Incubator | K.T. Parthiban, FCRI, TNAU |
| 11:35-11:50 | Agroforestry: Food and Nutritional Security | Stepha McMullin, CIFOR-ICRAF |
| 11:50-12:05 | Cacao Value Chain and Emerging Opportunities | Christophe Kouame and Alain A. Atangana, CIFOR-ICRAF |
| 12:05-12:20 | Open Discussion | All Participants |






















| Session 4: Panel Discussion on Regional Priorities (Research Areas, Capacity Development, Regulatory Policy Development & Public Awareness, and Possible Partnerships) to Achieve SDGs | | |
|---|--|--|
| Co-Chair: Dietmar Stoian , CIFOR-ICRAF Co-Chair: Helen Wallace , Griffith University | | |
| Rapporteur: Atul Dogra , CIFOR-ICRAF Rapporteur: Archna Singh , CIFOR-ICRAF | | |
| 12:20-12:35 | Priority Research and Innovation | Mi Sun Park, Seoul National University |
| 12:35-12:50 | Applications of Biotechnological Tools | Taichi Oguchi, University of Tsukuba |
| 12:50-13:00 | Developing Agroforestry Value Chains from the Perspective of Smallholders and Small and Medium Enterprises | Dietmar Stoian, CIFOR-ICRAF |
| 13:00-13:05 | Comfort Break | |
| 13:05-13:15 | Financing Smallholders and Small- and Medium-sized Enterprises (SMEs) | Harsh D. Kulkarni, ITC Ltd. |
| 13:15-13:30 | Agricultural Innovation System Perspective in Communication and Public Awareness | Martina Spisiakova, APAARI |
| 13:30-13:45 | Open Discussion | All Participants |

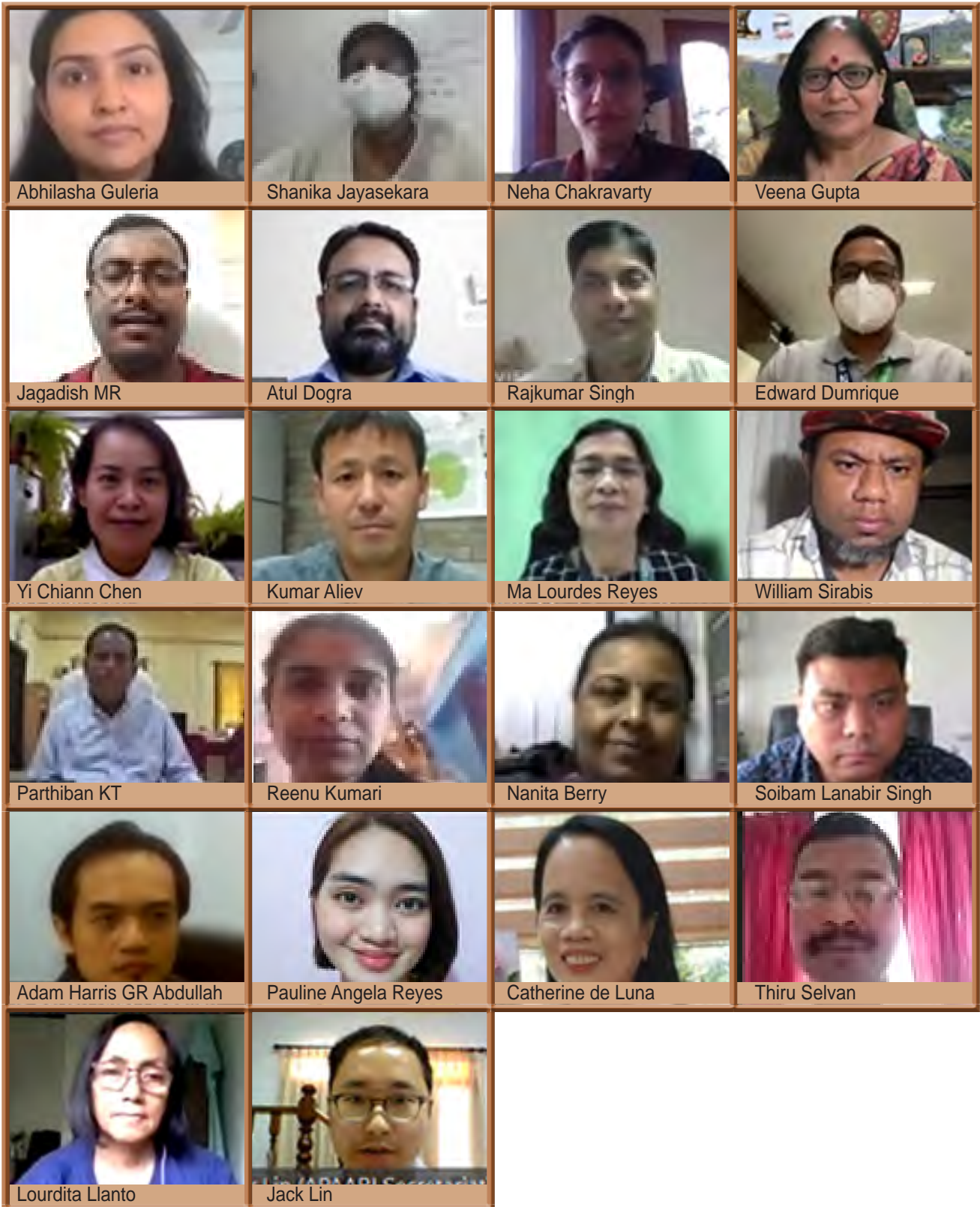
| Concluding Session | | |
|--|---|--|
| Co-Chair: Ravi Khetarpal , APAARI Co-Chair: Javed Rizvi , CIFOR-ICRAF | | |
| Rapporteur: Sunil Londhe , CIFOR-ICRAF Rapporteur: Devashree Nayak , CIFOR-ICRAF | | |
| 13:45-13:55 | Key Recommendations from Technical Sessions | Devashree Nayak, CIFOR-ICRAF |
| 13:55-14:00 | Any other Recommendations/Comments | Dignitaries/Participants |
| 14:00-14:10 | Concluding Remarks | Javed Rizvi, CIFOR-ICRAF Ravi Khetarpal, APAARI |
| 14:10-14:15 | Vote of Thanks | Jack Lin, APAARI |

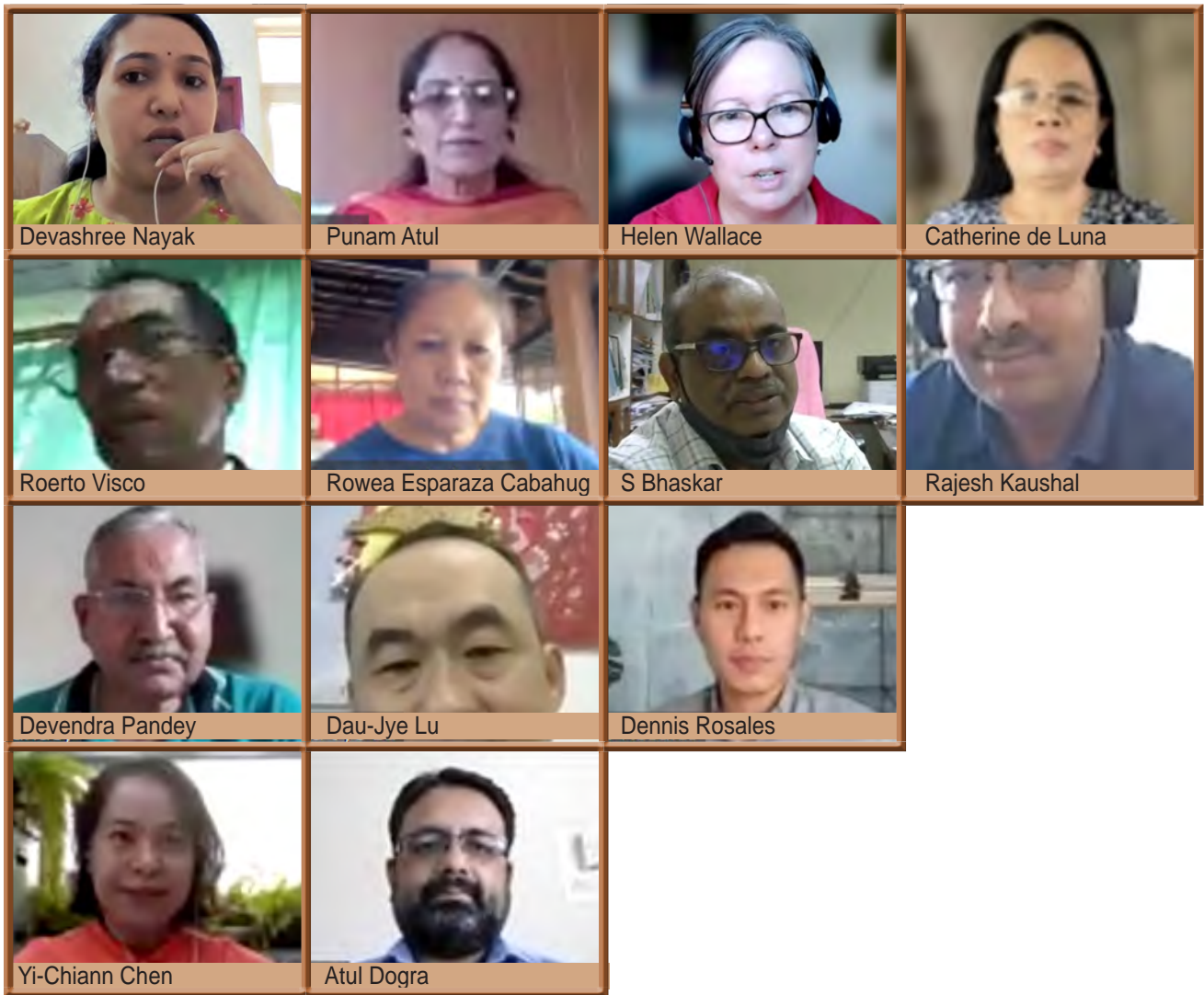


Virtual Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific

October 13-14, 2021

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|--|---|---|---|
|  Tony Simons |  Ravi Khetarpal |  Vincent LIN |  Rishi Tyagi |
|  Javed Rizvi |  Shiv Dhyani |  Devashree Nayak |  Ravi Prabhu |
|  Ramesh Singh |  Helen Wallace |  Md Abiar Rehman |  Feliciano Calora Jr. |
|  Chandrashekhhar Biradar |  K.T. Parthiban |  Stepha McMullin |  Dietmar Stoian |
|  Mi Sun Park |  Taichi Oguchi |  Archna Singh | |
|  Aqeel Hasan Rizvi |  Fen-Hui Chen | | |





Participants of Virtual Regional Expert Consultation on Agroforestry for Environmental Resilience and Sustainable Livelihoods of Farmers in Asia-Pacific (AFERSuLiF-AP)



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